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Environmental Protection Agency

LAKE MICHIGAN SHORE AND OPEN WATER REPORT 1972

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

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AUG. 26th 1818

Springfield, Illinois
Phone: 217/525-3397

The Honorable Daniel Walker
Governor, State of Illinois

Honorable Members of the 78th
General Assembly, State of Illinois

Gentlemen:

The Illinois Environmental Protection Agency presents its report of the results of the Lake Michigan Water Quality and Lake Bed Survey for 1972. This survey is conducted on a continuing basis to evaluate the ecology and the quality of Lake Michigan.

Data obtained during 1972 are presented in this report along with an evaluation of the present quality of the Illinois portion of Lake Michigan. Specific problems identified include concentrations of ammonia, phosphorus, and fecal coliform which continue to be found at undesirable levels at a large number of sampling stations. Surveys of the lake bed have identified areas of pollution at both near and off-shore stations.

It is recognized that pollution problems in Lake Michigan cannot be solved by any one State alone. The Agency is continuing to cooperate with other Lake States thru the Lake Michigan Toxic Substances Committee to compile the present state of knowledge on potentially harmful contaminants including the heavy metals, pesticides, PCB's, and phthalates, so that recommendations can be made to the States and actions taken before a serious problem develops.

The State of Illinois must maintain a continuing program of surveillance and monitoring on Lake Michigan to:

(1) determine the impact of various contaminants on the aquatic ecosystem;

(2) evaluate changes in lake quality that may effect economic or aesthetic values; and

(3) assess the effectiveness of measures taken by Illinois and other Lake States to control or eliminate pollutional discharges.

Sincerely,

Jack M Marco

Jack M. Marco
Acting Director

Acknowledgements

This report was prepared by the Lake Michigan Unit of the Division of Water Pollution Control. The authors were Robert Schacht, Lawrence Kolczak, and Wallace Matsunaga. The report was typed by Beverly Gregory. Graphics were provided by the Support Services Section. Sample analyses were performed by the Chicago and Champaign laboratories.

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WATER QUALITY EVALUATION, 1971-1972

pH - Values continued to be within the standard. There was no significant change in values between the two years.

AMMONIA - Values continued to frequently exceed the standard.

MBAS - Values were within the limits for the new standard. There was a slight increase from 1971.

CHLORIDES - Values were generally within the standards. There was no significant change in values between the two years.

CYANIDES - Values were generally within the standards. Four positive samples were found in 1972 collections.

FLUORIDES - Values continued to be generally within the standards. There was no significant change in values between the two years.

PHENOLS - Values continued to be within the standards. There was no significant change in values between the two years.

SULFATES - Values continued to be within the standards.

PHOSPHORUS - Based on the 1972 standard for unfiltered samples a high percentage of the samples exceeded the standard.

FILTRABLE RESIDUE - Values continued to be within the standards. There was no significant change between the two years.

RADIONUCLIDES - Values continued to be within the standards. There was no significant change in gross beta values between the two years.

FECAL COLIFORM - There was an increase in fecal coliform counts over 1971. The standard was most often exceeded at the North shore beaches.

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WATER QUALITY MONITORING

GENERAL INFORMATION

The State of Illinois conducts an on-going program of water quality and biological monitoring in Lake Michigan persuant to provisions of SB 1794 (75th General Assembly), which provide that the Agency ".... shall regularly conduct water quality and lake bed surveys to evaluate the ecology and the quality of water in Lake Michigan."

Data on lake water quality were obtained from (1) shore waters, (2) municipal water filtration plants and (3) lake monitoring stations located 5 miles offshore. Additional samples were collected within the Calumet Harbor basin to monitor water quality within this confined basin. Lake biological data are discussed in the section on Lake Bed Survey.

In March of 1971, following extensive public hearings, the Illinois Pollution Control Board revised the existing standards and adopted new regulations which included specific regulations for Lake Michigan. These revised regulations served as the bases for the evaluation of the 1972 data.

SHORE WATER

From April 4 through October 30, 1972, a total of thirty-one beaches from Winthrop Harbor to Chicago were monitored for water quality on a weekly basis. These beaches are identified in Figures 1 and 2.

Shore water quality is influenced by waste discharges to a greater extent than offshore or "open" water. The quality of shore waters is also affected adversely during wet weather periods when storm runoff, which includes sewage contamination from combined sewers, and bypasses from overloaded sewage treatment facilities are discharged to the shore waters.

OPEN WATERS

Raw water intakes at municipal water filtration plants which utilize Lake Michigan as their source of water supply were sampled to determine the quality of the open waters.

Raw water samples were collected for water quality determination on a twice per month schedule at these twelve water plants: Zion-Benton, Waukegan, North Chicago, Lake Forest, Highland Park, Glencoe, Winnetka, Kenilworth, Wilmette, Evanston, Chicago Central and Chicago South. Information of water plant intakes is presented in Table 11.

Additional water samples were collected by boat at eight stations located 5 miles offshore from the Illinois-Wisconsin State Line, Waukegan, Lake Bluff, Highland Park, Wilmette, Chicago (Montrose and Burnham Park Harbors) and Illinois-Indiana State Line. Surface, mid-depth and near bottom water samples were collected at each station for water quality monitoring during five cruises from June through October 1972.

Figure 1. Locations of North Shore beaches and facilities influencing their quality

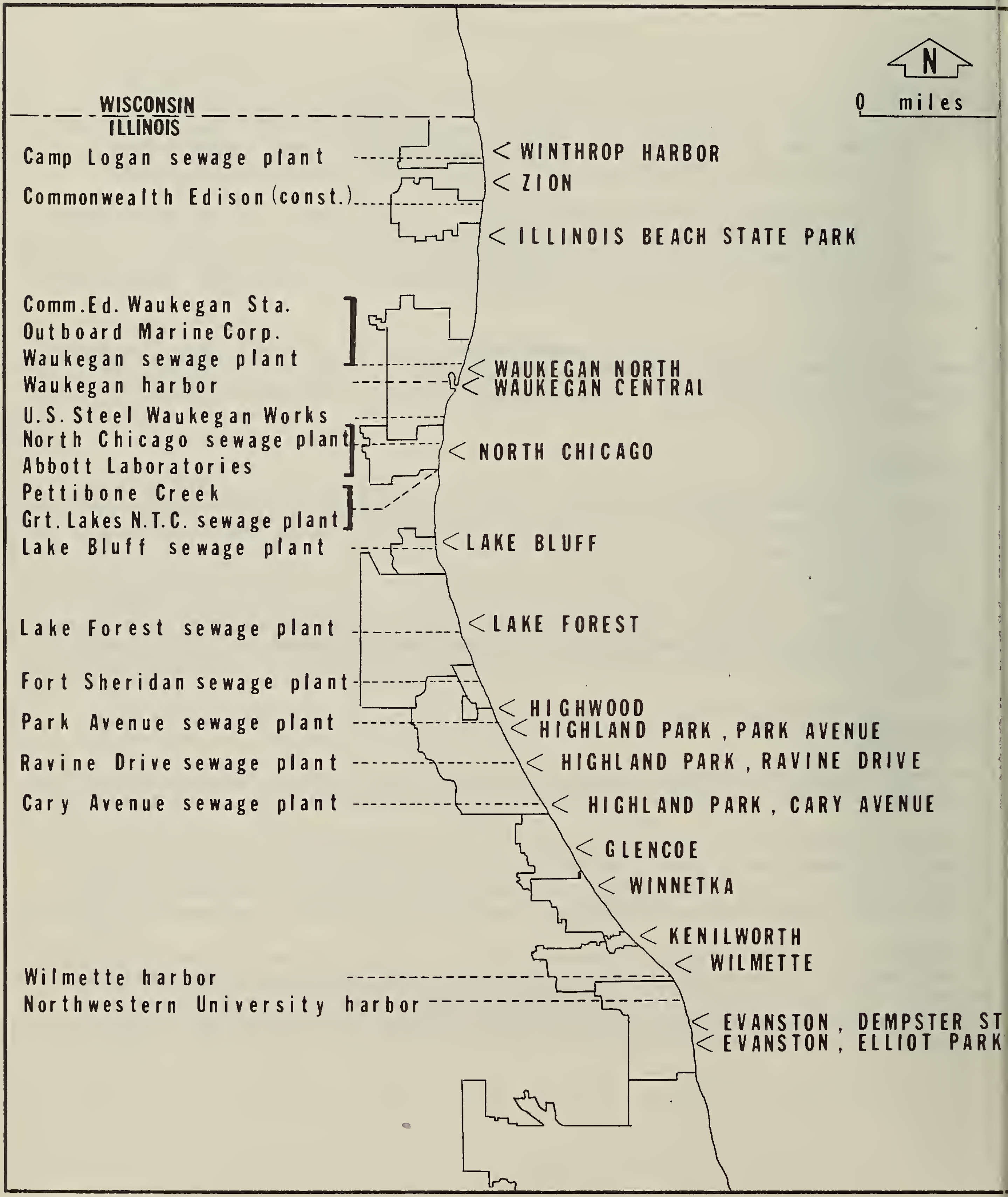
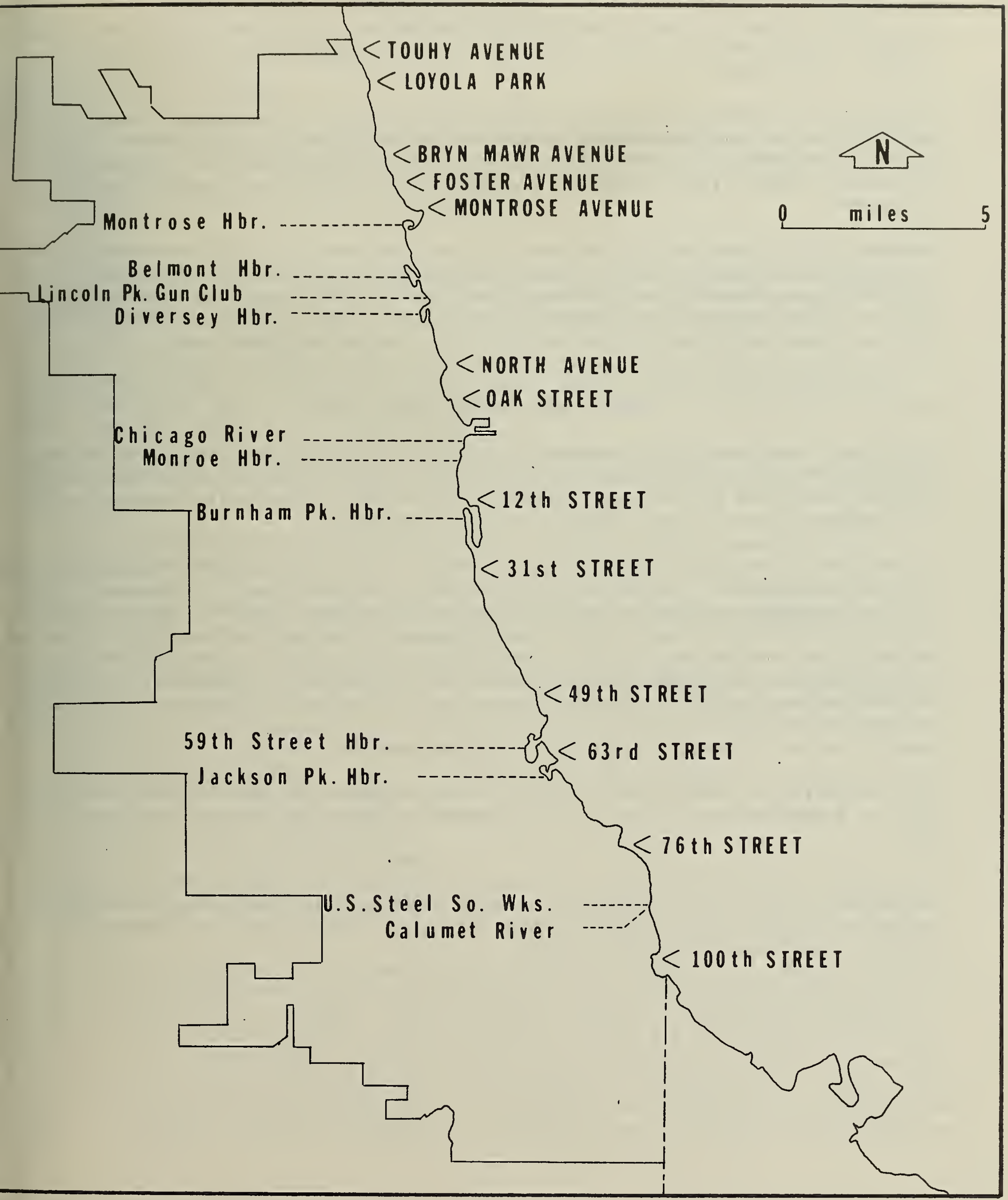


Figure 2. Locations of Chicago beaches and facilities influencing their quality



CALUMET HARBOR

Five monthly sampling runs, from June through October, were made in Calumet Harbor in 1972. Water samples within the harbor were collected at the State Line and Calumet River mouth.

Because of the configuration of the harbor and protecting breakwater, there are restrictions to the free exchange of water between the lake and the harbor. The resulting residence time within the basin, in conjunction with the local effects of industrial and storm discharges, results in water of degraded quality within the harbor.

Because of this particular situation, the evaluation of water quality is based on the general standards which are less stringent than the standards applicable to Lake Michigan. However, the standards applicable to the lake have been included in particular instances for comparative purposes. Also, where data from previous years were available, appropriate water quality comparisons were made.

FACTORS INFLUENCING WATER QUALITY

Discharges from industrial complexes located along the southwestern shore of Lake Michigan affect the quality of Illinois waters. Inadequately treated sewage effluents contribute to the lake's organic enrichment. Biologically degraded areas are commonly found in areas adjacent to such discharges.

In addition to man-made inputs to Lake Michigan, lake water quality is also affecte by natural phenomena. During most of the year, from about April to November, the lake is thermally stratified due to density differences between the warmer surface water and the colder, deep water. The formation of thermoclines during this period prevents the free exchange of dissolved oxygen between these layers and results in the reduction of dissolved oxygen near the lake bottom. Stratification is destroyed during late fall and spring overturns. Mixing occurs between the surface and bottom water during these overturns resulting in resuspension of settled bottom deposits which increase turbidity and mineral content.

Lake currents are another factor which influence water quality. Effluents may be carried a considerable distance from the point of discharge through physical transport.

Storm water runoff also affects lake water quality. Increases in bacteria counts, suspended and dissolved solids and in organic and nutrient levels can be expected following a storm. Additionally, visible floatage associated with storm water runoff is aesthetically objectionable.

WATER QUALITY MONITORING

BEACH SAMPLING

SUITABILITY FOR SWIMMING

The routine analysis of water samples for disease producing organisms is prohibited by the numerous varieties and the complexity of the laboratory procedures. Instead, a variety of bacteria, which have been shown to be closely associated with fecal contamination, are used as "indicator organisms."

In the absence of livestock and other warm blooded sources of feces, fecal coliform bacteria are considered to be reliable indicators of recent sewage contamination. Fecal coliforms are not generally considered harmful. As their concentration increases, however, so does the risk of encountering pathogenic organisms.

Neither bacterial standards, nor counts to which they apply reflect actual epidemiological findings. They are values chosen to insure that excessive hazards to public health do not exist, while not unduly reducing the availability of suitable waters for full body contact recreation.

The recreational waters of Illinois are considered acceptable for full body contact if;

a) No more than 10% of the samples have a fecal coliform concentration in excess of 400/100 ml.

b) If the geometric mean* of a minimum of five consecutive samples in any 30 day period does not exceed 200/100 ml.

Applying the standard to the results of the 1972 sampling season, the following stations were not in compliance.

Winthrop Harbor @ Main Street Beach
Zion @ Route 173 Beach
Lake Bluff @ Center Ave. Beach
Lake Forest @ Westminster Avenue Beach
Highwood @ Walker Avenue Beach
Highland Park @ Park Avenue Beach
Highland Park @ Ravine Drive Beach
Highland Park @ Cary Avenue Beach
Glencoe @ Park Ave. Beach

*The geometric mean is the average of the logarithms of a series of numbers. It tends to reduce the impact of several large values on a series of relatively small numbers. As an example, consider a hypothetical sampling station from which one hundred samples were collected. Assume that ninety-nine of these samples showed bacterial concentrations of 1/100 ml. and that only one of the analyses resulted in a count of 10,000/100 ml. The average of this series is 100/100 ml. The geometric mean, however, is 1/100 ml. and is a more accurate representation of the general condition of this sampling station.

For comparison, the results of the past several years were broken down by region. The number of individual samples exceeding 400/100 ml. is indicated as a percentage of the total number of samples collected within the designated region.

	1968	1969	1970	1971	1972
All 31 Illinois Stations	5%	9%	4%	4%	8%
12 Stations in Lake County	7%	16%	8%	5%	17%
19 Stations in Cook County	3%	5%	2%	3%	3%
13 Stations in Chicago	2%	4%	2%	3%	2%

The annual variations follow a pattern similar to that of the variations in rainfall. The majority of the excessive bacterial counts occur within Lake County and reveal the localized impact of inadequate sewers and sewage facilities. Wet weather compounds the problems of the overloaded transport and treatment systems.

BEACH CLOSINGS

In March of 1968, the Illinois Department of Public Health issued recommendations concerning bathing beaches and natural swimming areas. The following is an excerpt from that release.

> "Bathing beaches or natural and semi-artificial swimming areas having earth or sand bottoms are subject to varying degrees of contamination since such bodies of water receive variable amounts of surface water drainage. Although usually harmless, the contamination which is washed in can and often does include organisms which may cause infection, usually in the eyes and ears. If pollution from sewers, septic tanks, animal wastes, etc. have access to the swimming area, directly or indirectly, the possibility of contracting disease and infection, of course, is much greater."

And in the summary of the report:

> "Natural bathing areas as mentioned above, are not considered assuredly satisfactory for swimming from a public health standpoint."

The Lake County Health Department, in 1969, evaluated the combined bacterial data of their own sampling program as well as that of the North Shore Sanitary District and the Illinois Department of Public Health. They then recommended suspension of bathing at the Lake County beaches until the completion of engineering improvements which will prevent the discharge of sewage to the lake. Although certain interim improvements have been completed, the Lake County Health Department has maintained its 1969 recommendations.

Additional guidelines for evaluating the suitability of bathing beaches became effective in May 1972 under the Illinois Department of Public Health rules and regulations (paragraph 4.104). The regulation requires that water quality shall be evaluated by physical, chemical and bacteriological characteristics.

The individual municipalities and park districts are ultimately responsible for either following the Lake County Health Department recommendations or allowing swimming at their beaches. Most of the local authorities have followed the recommendations and posted either "no swimming" or "swim at your own risk" signs. Waukegan initiated a daily bacterial sampling program at its beaches and opens or closes them based on this information.

STATIONS MONITORED AND SAMPLING PROCEDURE

Thirty-one beaches listed below were the shore water sampling stations during 1972 (Figures 1 and 2). Samples were collected on a weekly schedule. Whenever necessary, an additional bacterial sampling run was made to comply with the sampling frequency requirements of the bacterial standard. The program began on April 4 and ended Oct. 30, with a total of twenty-seven routine samplings at each station.

NORTH SHORE BEACHES

Winthrop Harbor - Main Street
Zion - Route 173
Waukegan - North
Waukegan - Central
North Chicago - Foss Park
Lake Bluff - Center Avenue
Lake Forest - Westminster Avenue
Highwood - Walker Avenue
Highland Park - Park Avenue
Highland Park - Ravine Drive
Highland Park - Cary Avenue
Glencoe - Park Avenue
Winnetka - Lloyd Park
Kenilworth - Kenilworth Avenue
Wilmette - Lake Avenue
Evanston - Dempster Street
Evanston - Elliot Park

CHICAGO BEACHES

Touhy Avenue
Loyola Park
Bryn Mawr Avenue
Foster Avenue
Montrose Avenue
North Avenue
Oak Street
Roosevelt Road
31st Street
49th Street
63rd Street
76th Street
100th Street

Investigators waded into approximately 2½ ft. deep water and dipped samples from just below the surface. The cyanide, phenol and ammonia sampled were treated with preservatives to retard any chemical or biological alteration of their composition. Samples for bacterial analysis were collected in sterilized bottles and iced. Samples were delivered to the Chicago Laboratory of the Illinois Environmental Protection Agency within six hours of collection.

RAINFALL

Rainfall may have varied effects on the quality of shore water. Rain transports surface contamination through storm drains or directly as run-off. In Lake County communities, sewers and sewage treatment facilities become overloaded during wet weather and discharge an inadequately treated mixture of sewage and storm water. The result is increased bacterial counts at beaches in the immediate vicinity. At some beaches, rainfall interferes with heavy public use of the water and may result in a slight improvement in bacterial quality.

The following seasonal totals (April through October), expressed in inches, were reported by the U.S. Weather Bureau.

	Highland Park	Chicago (Midway)
1968	24.32	17.64
1969	31.29	29.08
1970	31.41	35.94
1971	19.61	15.89
1972	36.57	27.73

TEMPERATURE

The standard designates a specific allowable maximum for each month. The applicable standards are listed by month in table 1 below.

Table 1. Beach temperatures recorded April - October 1972 at 31 Illinois beaches

	MONTHLY MAXIMUM TEMPERATURES						
	April	May	June	July	Aug.	Sept.	Oct.
	ALLOWABLE MAXIMUMS						
Temperature	55°F	60°F	70°F	80°F	80°F	80°F	65°F
Winthrop Harbor	47	65	67	67	69	57	53
Zion	44	65	68	67	70	57	53
Ill. Bch St. Pk.	47	65	67	67	68	60	56
Waukegan North	54	65	72	67	69	65	54
Waukegan Central	53	65	71	69	75	68	54
North Chicago	55	65	70	68	69	64	55
Lake Bluff	52	64	70	66	68	65	57
Lake Forest	50	64	70	66	68	65	57
Highwood	52	64	70	67	68	65	57
H.P. Park Ave.	52	64	68	66	69	65	57
H.P. Ravine Dr.	52	64	70	67	71	65	58
H.P. Cary Ave.	52	63	71	66	70	65	57
Glencoe	50	63	68	66	69	66	57
Winnetka	56	63	74	68	71	67	58
Kenilworth	50	64	64	67	71	65	57
Wilmette	51	64	67	66	75	65	58
Evan. Dempster	52	64	63	66	75	65	55
Evan. Elliot Pk.	51	64	64	67	75	65	57
Touhy Ave.	51	65	66	66	74	65	58
Loyola Park	54	64	68	69	74	71	59
Bryn Mawr Ave.	51	64	67	71	74	73	58
Foster Ave.	51	64	66	70	74	70	60
Montrose Ave.	50	64	64	70	71	70	59
North Ave.	54	66	67	71	71	69	60
Oak Street	51	64	66	72	74	69	60
12th Street	50	64	68	74	70	69	60
31st Street	48	64	69	72	71	69	59
49th Street	48	62	64	70	70	69	59
63rd Street	49	65	71	76	68	69	59
76th Street	47	65	68	73	68	67	58
100th Street	56	66	72	73	71	70	59

TEMPERATURE (Continued)

Of the 963 readings taken, 40 (4%) were not in compliance with the standard. Thirty-one of these violations occurred on May 22 and all thirty-one sampling stations were involved. The other nine violations were scattered and consisted of temperatures one or two degrees above the standard. Frequently, the high reading fell on a day near the beginning of a new month, when the allowable maximum would be considerably higher.

pH

Standard: Between 7.0 and 9.0 pH units

Of the 832 samples analyzed none were in violation of the standard. The average pH was 8.3.

Table 2. Minimum, maximum and average pH values recorded at 31 Illinois beaches in 1972.

pH	AVERAGE CONCENTRATION pH unit	MIN. - MAX. CONCENTRATIONS pH units
WINTHROP HAR.	8.3	8.0 - 8.5
ZION	8.3	8.0 - 8.6
ILL. BCH. ST. PK.	8.3	8.0 - 8.5
WAUKEGAN NORTH	8.0	7.0 - 8.4
WAUKEGAN CENT.	8.3	8.0 - 8.6
NORTH CHICAGO	8.3	7.6 - 8.5
LAKE BLUFF	8.3	8.1 - 8.8
LAKE FOREST	8.0	7.9 - 8.6
HIGHWOOD	8.3	8.2 - 8.7
H.P. PARK AVE.	8.3	8.1 - 8.8
H.P. RAVINE DR.	8.3	8.0 - 8.7
H.P. CARY AVE.	8.3	8.0 - 8.7
GLENCOE	8.3	8.1 - 8.8
WINNETKA	8.3	7.9 - 8.5
KENILWORTH	8.3	8.0 - 8.6
WILMETTE	8.3	8.2 - 8.5
EVAN. DEMPSTER	8.3	8.1 - 8.6
EVAN. ELLIOT PK.	8.4	8.1 - 8.7
TOUHY AVE.	8.3	8.2 - 8.6
LOYOLA PARK	8.4	8.1 - 8.6
BRYN MAWR AVE.	8.4	8.2 - 8.6
FOSTER AVE.	8.4	8.1 - 8.7
MONTROSE AVE.	8.4	8.1 - 8.6
NORTH AVE.	8.3	8.2 - 8.5
OAK ST.	8.3	8.1 - 8.6
12TH ST.	8.4	8.1 - 8.6
31ST ST.	8.3	8.1 - 8.6
49TH ST.	8.3	8.0 - 8.5
63RD ST.	8.3	8.1 - 8.6
76TH ST.	8.3	8.2 - 8.6
100TH ST.	8.3	8.0 - 8.5

AMMONIA-NITROGEN (as N)

Standard: Maximum allowable concentration of 0.02 mg/l

Of the 832 samples analyzed, 638 (77%) were in excess of the standard. The average concentration detected was 0.14 mg/l. The Lake County beaches showed the greatest degree of non-compliance.

	Samples Exceeding Standard	Total Samples Collected	Per Cent Exceeding Standard	Average Concentration
12 Lake County Stations	264	322	82%	0.26 mg/l
19 Cook County Stations	374	510	73%	0.07 mg/l
13 Chicago Stations	259	348	74%	0.07 mg/l

Table 3. Minimum, maximum and average ammonia values recorded at 31 Illi beaches in 1972.

Ammonia-Nitrogen	SAMPLES EXCEEDING STANDARD COMPARED TO TOTAL NUMBER COLLECTED		AVERAGE CONCENTRATION mg/l	MIN. - MAX. CONCENTRATIONS mg/l
WINTHROP HAR.	21 of 27	78%	0.09	0.01 - 0.55
ZION	20 of 27	74%	0.07	0.01 - 0.20
ILL. BCH. ST. PK.	22 of 27	81%	0.09	0.01 - 0.20
WAUKEGAN NORTH	27 of 27	100%	1.88	0.05 - 9.00
WAUKEGAN CENT.	26 of 27	96%	0.26	0.02 - 3.30
NORTH CHICAGO	25 of 26	96%	0.26	0.01 - 0.97
LAKE BLUFF	24 of 27	89%	0.08	0.01 - 0.15
LAKE FOREST	20 of 27	74%	0.06	0.01 - 0.12
HIGHWOOD	21 of 26	81%	0.07	0.01 - 0.23
H.P. PARK AVE.	19 of 27	70%	0.10	0.01 - 0.90
H.P. RAVINE DR.	19 of 27	70%	0.06	0.01 - 0.15
H.P. CARY AVE.	21 of 27	78%	0.08	0.01 - 0.25
GLENCOE	21 of 27	78%	0.06	0.01 - 0.15
WINNETKA	19 of 27	70%	0.08	0.01 - 0.75
KENILWORTH	21 of 27	78%	0.07	0.01 - 0.20
WILMETTE	20 of 27	74%	0.06	0.01 - 0.20
EVAN. DEMPSTER	23 of 23	100%	0.07	0.00 - 0.32
EVAN. ELLIOT PK.	20 of 27	74%	0.06	0.01 - 0.20
TOUHY AVE.	21 of 27	78%	0.06	0.00 - 0.20
LOYOLA PARK	20 of 27	74%	0.05	0.01 - 0.10
BRYN MAWR AVE.	21 of 27	78%	0.06	0.01 - 0.30
FOSTER AVE.	18 of 27	67%	0.06	0.01 - 0.20
MONTROSE AVE.	18 of 27	67%	0.06	0.01 - 0.30
NORTH AVE.	19 of 27	70%	0.07	0.01 - 0.30
OAK ST.	16 of 27	59%	0.08	0.01 - 0.40
12TH ST.	19 of 27	70%	0.06	0.01 - 0.20
31ST ST.	22 of 27	81%	0.07	0.02 - 0.20
49TH ST.	17 of 24	71%	0.05	0.00 - 0.20
63RD ST.	19 of 27	70%	0.08	0.01 - 0.40
76TH ST.	17 of 27	63%	0.05	0.01 - 0.11
100TH ST.	23 of 27	85%	0.10	0.02 - 0.25

METHYLENE BLUE ACTIVE SUBSTANCES

There is no specific standard for this parameter. In waters used for drinking water supplies, the maximum allowable concentration at the point of intake is 0.5 mg/l.

The average concentration in the 832 samples analyzed was 0.17 mg/l. Nine samples had concentrations of MBAS in excess of 0.5 mg/l. Eight of those analyzed were from samples collected at Waukegan's North Beach. The ninth sample was from Glencoe's Park Avenue Beach. The concentrations detected and the dates involved are listed below.

April 4	0.80 mg/l	Waukegan
April 11	1.95 mg/l	Waukegan
April 17	0.65 mg/l	Waukegan
April 24	1.40 mg/l	Waukegan
May 8	0.65 mg/l	Waukegan
May 15	0.80 mg/l	Waukegan
May 22	1.60 mg/l	Waukegan
Oct. 10	0.80 mg/l	Glencoe

CHLORIDE

Standard: Maximum allowable concentration of 12 mg/l

Of the 816 samples analyzed, 123 (15%) had concentrations in excess of the standard. The average concentration of chloride detected was 11 mg/l. The Lake County beaches showed the greatest degree of non-compliance. Table 4 summarizes the regional differences.

Table 4. Minimum, maximum and average chloride values recorded at 31 Illinois beaches in 1972.

Chloride	SAMPLES EXCEEDING STANDARD COMPARED TO TOTAL NUMBER COLLECTED		AVERAGE CONCENTRATION mg/l	MIN. - MAX. CONCENTRATIONS mg/l
WINTHROP HAR.	5 of 26	19%	10	8 - 15
ZION	5 of 26	19%	11	8 - 16
ILL. BCH. ST. PK.	7 of 26	27%	11	8 - 17
WAUKEGAN NORTH	15 of 26	58%	37	8 - 150
WAUKEGAN CENT.	7 of 26	27%	12	8 - 21
NORTH CHICAGO	10 of 25	40%	13	8 - 28
LAKE BLUFF	4 of 26	15%	11	8 - 18
LAKE FOREST	4 of 26	15%	10	8 - 19
HIGHWOOD	5 of 25	20%	11	8 - 18
H.P. PARK AVE.	6 of 26	23%	11	8 - 26
H.P. RAVINE DR.	8 of 26	31%	11	8 - 30
H.P. CARY AVE.	7 of 26	27%	12	8 - 42
GLENCOE	5 of 26	19%	10	8 - 16
WINNETKA	4 of 26	15%	10	8 - 16
KENILWORTH	3 of 27	11%	10	8 - 15
WILMETTE	2 of 27	7%	9	8 - 15
EVAN. DEMPSTER	1 of 27	4%	9	8 - 16
EVAN. ELLIOT PK.	1 of 27	4%	9	8 - 15
TOUHY AVE.	1 of 27	4%	9	8 - 15
LOYOLA PARK	1 of 27	4%	9	8 - 15
BRYN MAWR AVE.	1 of 27	4%	9	8 - 14
FOSTER AVE.	2 of 27	7%	9	8 - 14
MONTROSE AVE.	1 of 27	4%	9	8 - 14
NORTH AVE.	1 of 26	4%	9	8 - 13
OAK ST.	0 of 27	0%	9	8 - 12
12TH ST.	2 of 27	7%	9	8 - 15
31ST ST.	2 of 27	7%	9	8 - 14
49TH ST.	2 of 24	8%	9	8 - 14
63RD ST.	4 of 26	15%	10	8 - 14
76TH ST.	2 of 27	7%	9	8 - 13
100TH ST.	5 of 27	18%	10	8 - 14

	Samples Exceeding Standard	Total Samples Collected	Per Cent Exceeding Standard	Average Concentrati
12 Lake County Stations	83	310	27%	13
19 Cook County Stations	40	506	8%	9
13 Chicago Stations	25	346	7%	9

CYANIDE

General Standard: Maximum allowable concentration of 0.025 mg/l

Of the 464 analyses performed, there were four samples in which cyanide was detecte All four samples were from Waukegan's North beach, and all of the detections were in excess of the standard. The concentrations and dates are listed below.

April	4	0.08 mg/l
June	12	0.14 mg/l
October	2	0.10 mg/l
October	16	0.10 mg/l

FLUORIDE

Standard: Maximum allowable concentration of 1.4 mg/l

None of the 247 samples had concentrations in excess of the standard. The average concentration was 0.1 mg/l and the maximum was 0.2 mg/l

PHENOL

General Standard: Maximum allowable concentration of 0.100 mg/l

None of the 450 samples had concentrations of phenol in excess of the standard. Th only station at which phenol was present in detectable concentrations was Waukegan' North beach. The dates of the samplings and the concentrations detected are listed below:

April	4	0.029 mg/l
April	17	0.015 mg/l
May	15	0.017 mg/l
June	26	0.010 mg/l
October	2	0.070 mg/l

SULFATE

Standard: Maximum allowable concentration of 24 mg/l

Of the 818 samples analyzed, 44 (5%) exceeded the standard. The average concentration was 16 mg/l. Lake County beaches showed the greatest degree of non-compliance. Table 5 summarizes regional differences.

Table 5. Minimum, maximum and average sulfate values recorded at 31 Illinois beaches in 1972.

Sulfate	SAMPLES EXCEEDING STANDARD COMPARED TO TOTAL NUMBER COLLECTED		AVERAGE CONCENTRATION mg/l	MIN. - MAX. CONCENTRATIONS mg/l
WINTHROP HAR.	2 of 26	8%	18	8 - 44
ZION	3 of 26	12%	17	9 - 33
ILL. BCH. ST. PK.	1 of 26	4%	16	10 - 28
WAUKEGAN NORTH	9 of 26	35%	33	8 - 99
WAUKEGAN CENT.	4 of 26	15%	19	10 - 36
NORTH CHICAGO	5 of 25	20%	21	9 - 57
LAKE BLUFF	3 of 26	12%	17	8 - 31
LAKE FOREST	2 of 26	8%	17	8 - 34
HIGHWOOD	2 of 25	8%	17	10 - 29
H.P. PARK AVE.	1 of 26	4%	16	11 - 25
H.P. RAVINE DR.	1 of 26	4%	16	9 - 29
H.P. CARY AVE.	3 of 26	12%	17	9 - 55
GLENCOE	1 of 26	4%	16	9 - 25
WINNETKA	0 of 26	0%	16	8 - 23
KENILWORTH	2 of 27	7%	15	10 - 28
WILMETTE	1 of 27	4%	15	8 - 25
EVAN. DEMPSTER	0 of 27	0%	14	8 - 23
EVAN. ELLIOT PK.	1 of 27	4%	14	9 - 25
TOUHY AVE.	0 of 27	0%	14	8 - 24
LOYOLA PARK	0 of 27	0%	14	8 - 21
BRYN MAWR AVE.	0 of 27	0%	14	6 - 21
FOSTER AVE.	1 of 27	4%	15	6 - 26
MONTROSE AVE.	0 of 27	0%	14	8 - 24
NORTH AVE.	1 of 27	4%	14	9 - 26
OAK ST.	0 of 27	0%	14	9 - 22
12TH ST.	0 of 27	0%	15	10 - 21
31ST ST.	0 of 27	0%	14	8 - 20
49TH ST.	0 of 24	0%	14	7 - 20
63RD ST.	1 of 27	4%	15	8 - 32
76TH ST.	0 of 27	0%	14	9 - 21
100TH ST.	0 of 27	0%	16	9 - 24

	Samples Exceeding Standard	Total Samples Collected	Per Cent Exceeding Standard	Average Concentration
12 Lake County Stations	36	310	12%	19
19 Cook County Stations	8	508	2%	15
13 Chicago Stations	3	348	1%	14

PHOSPHORUS (as P)

Standard: Maximum allowable concentration of 0.007 mg/1

Of the 832 samples analyzed, 751 (90%) were in excess of the standard. The overall average concentration was 0.070 mg/1. Lake County stations had an average concentration twice that of the Cook County stations. Table 6 summarizes the regional differences.

Table 6. Minimum, maximum and average phosphorus values recorded at 31 Illinois beaches in 1972.

Phosphorus	SAMPLES EXCEEDING STANDARD COMPARED TO TOTAL NUMBER COLLECTED		AVERAGE CONCENTRATION mg/l	MIN. - MAX. CONCENTRATIONS mg/l
WINTHROP HAR.	26 of 27	96%	0.093	0.000 - 0.370
ZION	25 of 27	93%	0.095	0.000 - 0.215
ILL. BCH. ST. PK.	27 of 27	100%	0.063	0.010 - 0.160
WAUKEGAN NORTH	26 of 27	96%	0.164	0.000 - 0.625
WAUKEGAN CENT.	26 of 27	96%	0.089	0.007 - 0.480
NORTH CHICAGO	26 of 26	100%	0.151	0.020 - 0.680
LAKE BLUFF	26 of 27	96%	0.101	0.000 - 0.260
LAKE FOREST	26 of 27	96%	0.065	0.000 - 0.170
HIGHWOOD	25 of 26	96%	0.095	0.000 - 0.330
H.P. PARK AVE.	26 of 27	96%	0.131	0.000 - 0.580
H.P. RAVINE DR.	26 of 27	96%	0.086	0.000 - 0.390
H.P. CARY AVE.	27 of 27	100%	0.081	0.010 - 0.340
GLENCOE	26 of 27	96%	0.060	0.000 - 0.200
WINNETKA	25 of 27	93%	0.117	0.000 - 1.800
KENILWORTH	24 of 27	89%	0.070	0.000 - 0.480
WILMETTE	27 of 27	100%	0.057	0.010 - 0.160
EVAN. DEMPSTER	23 of 27	85%	0.060	0.000 - 0.240
EVAN. ELLIOT PK.	24 of 27	89%	0.044	0.000 - 0.130
TOUHY AVE.	25 of 27	92%	0.056	0.000 - 0.240
LOYOLA PARK	24 of 27	89%	0.054	0.000 - 0.200
BRYN MAWR AVE.	26 of 27	96%	0.050	0.000 - 0.290
FOSTER AVE.	23 of 27	85%	0.068	0.000 - 0.470
MONTROSE AVE.	24 of 27	89%	0.068	0.000 - 0.520
NORTH AVE.	22 of 27	81%	0.030	0.000 - 0.140
OAK ST.	18 of 27	67%	0.029	0.000 - 0.170
12TH ST.	20 of 27	74%	0.032	0.000 - 0.200
31ST ST.	23 of 27	85%	0.039	0.000 - 0.180
49TH ST.	15 of 24	62%	0.019	0.000 - 0.150
63RD ST.	25 of 27	92%	0.039	0.000 - 0.095
76TH ST.	21 of 27	78%	0.033	0.000 - 0.060
100TH ST.	24 of 27	89%	0.034	0.000 - 0.120

	Samples Exceeding Standard	Total Samples Collected	Per Cent of Samples in Excess Standard	Average Concentration
12 Lake County Stations	312	322	97%	0.101 mg/1
19 Cook County Stations	439	510	86%	0.050 mg/1
13 Chicago Stations	290	348	83%	0.042 mg/1

TOTAL DISSOLVED SOLIDS

Standard: Maximum allowable concentration of 180 mg/l

Of the 818 samples collected, 85 (10%) had concentrations of dissolved solids in excess of the standard. The average concentration detected was 172 mg/l. The Lake County stations showed a greater degree of non-compliance than the others.

Table 7. Minimum, maximum and average total dissolved solids values recorded at 31 Illinois beaches in 1972.

Dissolved Solids	SAMPLES EXCEEDING STANDARD COMPARED TO TOTAL NUMBER COLLECTED		AVERAGE CONCENTRATION mg/l	MIN. - MAX. CONCENTRATIONS mg/l	
WINTHROP HAR.	6 of 26	23%	174	160	204
ZION	6 of 26	23%	182	160	210
ILL. BCH. ST. PK.	7 of 26	27%	172	160	198
WAUKEGAN NORTH	14 of 26	54%	266	160	648
WAUKEGAN CENT.	7 of 26	27%	176	160	210
NORTH CHICAGO	10 of 25	40%	182	160	240
LAKE BLUFF	3 of 26	12%	176	160	186
LAKE FOREST	3 of 26	12%	170	160	192
HIGHWOOD	6 of 25	24%	171	150	198
H.P. PARK AVE.	4 of 26	15%	170	160	192
H.P. RAVINE DR.	4 of 26	15%	172	160	252
H.P. CARY AVE.	4 of 26	15%	175	160	276
GLENCOE	1 of 26	4%	167	156	186
WINNETKA	2 of 26	8%	167	150	192
KENILWORTH	0 of 27	0%	165	160	180
WILMETTE	1 of 27	4%	166	162	186
EVAN. DEMPSTER	0 of 27	0%	165	160	180
EVAN. ELLIOT PK.	0 of 27	0%	165	160	180
TOUHY AVE.	1 of 27	4%	165	160	186
LOYOLA PARK	1 of 27	4%	165	160	186
BRYN MAWR AVE.	0 of 27	0%	163	150	180
FOSTER AVE.	0 of 27	0%	164	160	174
MONTROSE AVE.	0 of 27	0%	165	160	180
NORTH AVE.	0 of 27	0%	165	160	174
OAK ST.	0 of 27	0%	163	160	174
12TH ST.	1 of 27	4%	166	160	186
31ST ST.	0 of 27	0%	166	160	174
49TH ST.	0 of 24	0%	165	160	174
63RD ST.	0 of 27	0%	165	150	180
76TH ST.	0 of 27	0%	163	150	174
100TH ST.	4 of 27	15%	171	160	192

	Samples Exceeding Standard	Total Samples Collected	Per Cent Exceeding Standard	Average Concentration
12 Lake Co. Stations	74	310	24%	182
19 Cook Co. Stations	11	508	2%	165
13 Cook Co. Stations	7	348	2%	165

RADIOACTIVITY

Gross Alpha emitters shall not exceed 3 pCi/l
Gross Beta emitters shall not exceed 100 pCi/l

During 1972, eight samples from each of ten stations were analyzed for radioactivity. The parameters monitored were gross alpha and gross beta emitters. The alpha emitters ranged from 0 to 2 pico curies/liter. The beta emitters ranged from 0 to 23 pico curies/liter. None of the results exceeded the standard.

FECAL COLIFORM

Standard: Based on a minimum of five samples taken over not more than a 30 day period, fecal coliforms shall not exceed a geometric mean of 20 per 100 ml.

Lake County stations show the greatest per cent of samples exceeding the standard. (A separate section dealing with the fecal coliform standard for full body contact recreation can be found in the beach closings portion of this report.)

Table 8. Geometric mean values for fecal coliform recorded at the Illinois beaches in 1972.

All 31 Stations in Illinois	315 of 923	34%
12 Stations within Lake County	203 of 358	57%
19 Stations within Cook County	112 of 565	20%
13 Stations within Chicago	36 of 385	9%

Fecal Coliform	CONSECUTIVE FIVE SAMPLE GEOMETRIC MEANS EXCEEDING THE STANDARD		ANNUAL GEOM. MEAN #/100 ml.
WINTHROP HAR.	13 of 30	43%	32
ZION	15 of 30	50%	36
ILL. BCH. ST. PK.	8 of 30	27%	16
WAUKEGAN NORTH	7 of 30	23%	8
WAUKEGAN CENT.	16 of 30	53%	21
NORTH CHICAGO	6 of 30	20%	7
LAKE BLUFF	22 of 30	73%	73
LAKE FOREST	19 of 30	63%	26
HIGHWOOD	23 of 29	79%	59
H.P. PARK AVE.	26 of 30	87%	174
H.P. RAVINE DR.	28 of 30.	93%	91
H.P. CARY AVE.	20 of 30	67%	41
GLENCOE	28 of 30	93%	54
WINNETKA	17 of 30	57%	31
KENILWORTH	8 of 30	27%	13
WILMETTE	17 of 30	57%	18
EVAN. DEMPSTER	2 of 30	7%	6
EVAN. ELLIOT PK.	4 of 30	13%	7
TOUHY AVE.	2 of 30	7%	12
LOYOLA PARK	0 of 30	0%	1
BRYN MAWR AVE.	0 of 30	0%	4
FOSTER AVE.	4 of 30	13%	6
MONTROSE AVE.	4 of 30	13%	7
NORTH AVE.	7 of 29	24%	9
OAK ST.	0 of 30	0%	4
12TH ST.	0 of 30	0%	3
31ST ST.	4 of 30	13%	5
49TH ST.	0 of 27	0%	2
63RD ST.	0 of 30	0%	5
76TH ST.	0 of 30	0%	3
100TH ST.	15 of 30	50%	17

NITRATE AND NITRITE (as N)

There is no specific standard for these parameters in shore water. However, a standard for water designated as drinking water supply at the point of intake is 10.0 mg/l as N.

Of the 832 analyses performed only six were in excess of 1.0 mg/l. These six samples were from the Waukegan North Beach and ranged from 1.1 to 3.0 mg/l. The average values of the 832 samples was 0.3 mg/l. The average value for Waukegan's North Beach was 0.8 mg/l.

METALS

Table 9 shows the concentrations of heavy metals found in the shore water. Iron and Manganese were the only metals detected frequently. Iron (total) averaged 0.40 mg/l. Iron (dissolved) averaged 0.03 mg/l. Manganese averaged 0.02 mg/l.

Table 9. Minimum, maximum and average values for the heavy metals found at 31 Illinois beaches in 1972.

(Milligrams per liter)

	MINIMUM	MAXIMUM	AVERAGE
Arsenic	0.00	0.00	0.00
Barium	0.00	0.20	0.00
Boron	0.00	0.20	0.00
Cadmium	0.00	0.00	0.00
Chromium (Hex)	0.00	0.00	0.00
Chromium (Tri)	0.00	0.00	0.00
Chromium (Total)	0.00	0.00	0.00
Copper	0.00	0.10	0.00
Iron (Total)	0.00	5.20	0.40
Iron (Dissolved)	0.00	0.26	0.03
Lead	0.00	0.10	0.00
Manganese	0.00	0.20	0.02
Mercury	0.00	0.00	0.00
Nickel	0.00	0.00	0.00
Selenium	0.00	0.00	0.00
Silver	0.00	0.00	0.00
Zinc	0.00	0.20	0.00

COLOR

No current standard for color applies to Lake Michigan shore water. The previous standards (SWB-7) allowed an average of 5 color units and a maximum of 15 color units. The overall average of the 769 analyses was 4 color units.

The beaches at Winthrop Harbor, Zion, Waukegan North, and North Chicago had average readings of 6 color units. The individual readings in excess of 15 color units are listed below.

Winthrop Harbor	20 units	April 17	Ill. Bch. St. Pk.	20 units	April 17
Winthrop Harbor	18 units	April 24	Waukegan North	25 units	April 24
Zion	20 units	April 17	Waukegan North	17 units	May 8
Zion	20 units	April 24	Waukegan North	18 units	May 22
Zion	17 units	May 8			

WATER QUALITY MONITORING

WATER PLANT SAMPLING

TOTAL COLIFORM

Total coliform counts ranged from 5/100 ml at the Waukegan water plant to 1000/100 ml at the Zion-Benton, Highland Park, Winnetka and Chicago Central water plants. The highest annual average count, 152/100 ml, was recorded at the Kenilworth water plant.

Table 10. Minimum, maximum and average total coliform values recorded at water filtration plants in 1972.

(Number per 100 milliliter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	1	1000	129
Waukegan	1	5	1
North Chicago	1	40	4
Lake Forest	1	300	55
Highland Park	1	1000	102
Glencoe	1	350	69
Winnetka	1	1000	112
Kenilworth	1	800	152
Wilmette	2	450	92
Evanston	1	400	61
Chicago Central	1	1000	56
Chicago South	1	150	18
Former SWB-7 Standards:		2500	200

In 1968-1972, the annual average counts for all plants were:

1968	141/100 ml
1969	93/100 ml
1970	29/100 ml
1971	43/100 ml
1972	70/100 ml

Table 11. Location of raw water intakes monitored.

Name of Plant	Number of Intakes	Distance of Intake from Shore (ft.)	Depth dra from (ft.
Zion-Benton	1	2,700	37
Waukegan	2	Shore	5
		6,200	35
North Chicago	1	6,500	28
Lake Forest	2	3,900	24
		6,500	30
Highland Park	3	1,000	9
		2,000	20
		3,500	28
Glencoe	2	2,000	25
		3,300	18
Winnetka	2	1,200	20
		3,000	15
Kenilworth	1	2,100	20
Wilmette	2	3,300	21
		4,500	29
Evanston	3	1,800	16
		2,600	18
		5,600	28
Chicago Central	2	Shore	20
		13,000	35
Chicago South	2	Shore	24
		12,100	32

FECAL STREPTOCOCCI

In 1972, the maximum fecal streptococci counts at the water plants ranged from 4 to 260/100 ml. The highest count was recorded at the Zion-Benton water plant. Of the 269 samples analyzed for fecal streptococci, 3.3% exceeded the former standard.

Table 12. Minimum, maximum and average fecal streptococci values recorded at water filtration plants in 1972.

(Number per 100 milliliter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	1	260	20
Waukegan	1	14	2
North Chicago	1	4	1
Lake Forest	1	100	7
Highland Park	1	40	6
Glencoe	1	28	4
Winnetka	1	68	5
Kenilworth	1	24	4
Wilmette	1	34	3
Evanston	1	42	4
Chicago Central	1	8	2
Chicago South	1	6	2
Former SWB-7 limit:		25	

During 1968-1972, the annual average fecal streptococci counts for all plants and per cent violations were:

1968	8/100 ml	(6.0%)
1969	4/100 ml	(3.5%)
1970	2/100 ml	(1.0%)
1971	6/100 ml	(3.5%)
1972	5/100 ml	(3.3%)

TURBIDITY

Standard: Shall be free from unnatural turbidity

The application of this standard is based on visual observations. In 1972, no unnatural turbidity was observed in the open waters of Lake Michigan.

Turbidity analyses were also conducted in the laboratory. However, since laboratory results are reported as numerical values which are not directly compatible with the turbidity standard, the recommendation of the National Technical Advisory Committee to the Secretary of the Interior (Water Quality Criteria, 1968) was used as a guideline for evaluation purposes. The Committee recommended that "The turbidity of cold-water or oligotrophic lakes [such as Lake Michigan] should not exceed 10 units."

During the year 45.4% of the samples exceeded the guideline value. The maximum values at the water plants ranged from 18 JTU at the Chicago Central plant to 185 JTU at the Lake Forest plant.

Table 13. Minimum, maximum, and average turbidity values recorded at water filtration plants in 1972.

(Jackson Turbidity Units)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVE
Zion-Benton	1	22	11
Waukegan	1	70	11
North Chicago	1	40	10
Lake Forest	1	185	23
Highland Park	2	50	15
Glencoe	1	44	13
Winnetka	0	48	13
Kenilworth	1	55	19
Wilmette	2	80	19
Evanston	1	80	17
Chicago Central	1	18	7
Chicago South	0	22	7

Annual average turbidity values from 1969-1972 and the percentage of samples exceeding 10 JTU were:

1969	15 JTU	(42.1%)
1970	9 JTU	(22.2%)
1971	13 JTU	(38.7%)
1972	14 JTU	(45.5%)

ODOR

Standard: Shall be free from odor.

There were no significant odors in the raw water samples collected from water plant intakes in 1972. The data from 1968 to 1972 indicate that no odors were detected in water samples collected during this period.

VISIBLE OIL

Standard: Shall be free from visible oil

Water samples collected from the municipal water treatment plants in 1972 did not contain visible oil. This was also true for the sampling period from 1968 to 1972.

FLOATING DEBRIS

Standard: Shall be free from floating debris

Floating debris were not observed in the water samples obtained from the municipal water plants in 1972. This is consistent with the observations made since 1968. In this 5-year period, floating debris was not observed in any of the samples from the water plants.

TEMPERATURE

Standard: The water temperature shall not exceed the maximum limits (°F) indicated in the following table:

JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEPT.	OCT.	NOV.	DEC.
45	45	45	55	60	70	80	80	80	65	60	50

During 1972, the monthly temperature limit was exceeded in May, November and December. In May, the temperature limit was exceeded at the Kenilworth (61°F), Evanston (62°F) and Chicago South (61°F) plants. The November limit was exceeded at the Highland Park (61°F) plant, and the limit for December was exceeded at the Waukegan (51°F) and Highland Park (64°F) plants. These excessive temperatures constitute 2.3% of all the temperature readings obtained from the water plants in 1972.

Table 14. Maximum monthly temperatures recorded at water filtration plants in 1972.

(Degrees Fahrenheit)

WATER FILTRATION PLANT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	D
Zion-Benton	37	35	41	41	55	58	53	--	62	57	41	4
Waukegan	35	34	38	42	54	58	57	74	67	60	--	5
North Chicago	34	35	38	42	57	58	57	60	62	52	41	3
Lake Forest	35	36	39	43	59	58	58	65	64	58	46	4
Highland Park	37	36	41	45	60	63	62	73	69	57	61	6
Glencoe	34	33	38	46	59	58	54	63	65	55	40	3
Winnetka	35	33	38	45	60	58	58	67	67	57	41	3
Kenilworth	34	33	38	44	61	57	64	69	67	57	42	3
Wilmette	34	33	37	46	59	57	57	64	65	57	42	3
Evanston	38	37	38	46	62	59	58	67	68	59	43	3
Chicago Central	39	37	42	46	58	62	61	66	67	63	46	4
Chicago South	37	37	42	46	61	62	65	70	69	62	42	4
PCB limits:	45	45	45	55	60	70	80	80	80	65	60	5

The annual average temperatures for the period 1969-1972 and the percent of violations based on the new temperature regulations are indicated below:

1969	48°F	(4.0%)
1970	55°F	(1.7%)
1971	50°F	(1.2%)
1972	49°F	(2.3%)

pH

Standard: Shall be within the range of 7.0 to 9.0 except for natural causes.

In 1972, all pH values were within the prescribed limits. Values ranged from 7.5 to 8.8; the minimum value of 7.5 was recorded at the Winnetka and Lake Fores water plants and the maximum value of 8.8 was recorded at the Evanston plant.

Table 15. Minimum, maximum and average pH values recorded at water filtration plants in 1972.

(ph Units)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	7.8	8.6	8.2
Waukegan	7.8	8.6	8.2
North Chicago	7.7	8.6	8.2
Lake Forest	7.5	8.5	8.2
Highland Park	7.6	8.5	8.2
Glencoe	8.0	8.5	8.2
Winnetka	7.5	8.5	8.1
Kenilworth	7.7	8.6	8.2
Wilmette	8.0	8.6	8.3
Evanston	7.9	8.8	8.3
Chicago Central	7.9	8.6	8.3
Chicago South	7.8	8.6	8.2
PCB limits:	7.0	9.0	

During 1968-1972, the annual average pH values remained within a very narrow range as indicated below. No violations of the 1972 standard occurred during this period.

1968	8.3
1969	8.2
1970	8.3
1971	8.3
1972	8.3

AMMONIA NITROGEN (as N)

Standard: Shall not exceed 0.02 mg/l

In 1972, 70% of all samples analyzed for ammonia nitrogen exceeded 0.02 mg/l. Maximum values ranged from 0.08 mg/l at the Highland Park and Chicago South water plants to 0.40 mg/l at the Kenilworth water plant.

Table 16. Minimum, maximum and average ammonia (N) values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERA
Zion-Benton	0.00	0.10	0.05
Waukegan	0.00	0.10	0.04
North Chicago	0.00	0.20	0.05
Lake Forest	0.01	0.20	0.06
Highland Park	0.00	0.08	0.04
Glencoe	0.00	0.20	0.06
Winnetka	0.01	0.30	0.08
Kenilworth	0.00	0.40	0.07
Wilmette	0.01	0.20	0.06
Evanston	0.00	0.10	0.04
Chicago Central	0.00	0.12	0.04
Chicago South	0.00	0.08	0.04
PCB limit:		0.02	

During 1968-1972, the annual average ammonia nitrogen values and the percent of samples in excess of the 1972 standard were:

1968	0.10 mg/l	(36.8%)
1969	0.05 mg/l	(31.5%)
1970	0.02 mg/l	(12.1%)
1971	0.04 mg/l	(55.0%)
1972	0.05 mg/l	(70.0%)

METHYLENE BLUE ACTIVE SUBSTANCE

Standard: Shall not exceed 0.5 mg/l

MBAS concentrations were below the standard at all plants in 1972. Maximum values ranged from 0.20 mg/l at the Waukegan, North Chicago, Lake Forest and Wilmette plants to 0.40 mg/l at the Evanston water plant.

Table 17. Minimum, maximum and average values of MBAS recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.10	0.25	0.15
Waukegan	0.10	0.20	0.15
North Chicago	0.10	0.20	0.15
Lake Forest	0.10	0.20	0.16
Highland Park	0.10	0.25	0.17
Glencoe	0.10	0.25	0.16
Winnetka	0.10	0.30	0.18
Kenilworth	0.10	0.25	0.15
Wilmette	0.10	0.20	0.15
Evanston	0.10	0.40	0.17
Chicago Central	0.10	0.30	0.15
Chicago South	0.10	0.30	0.16
PCB limit:		0.5	

During 1968-1972, the annual average MBAS values were:

1968	0.05 mg/l
1969	0.05 mg/l
1970	0.05 mg/l
1971	0.11 mg/l
1972	0.16 mg/l

CHLORIDE

Standard: Shall not exceed 12 mg/l

The maximum values at the water plants ranged from 11 mg/l at the Chicago Central plant to 14 mg/l at the Evanston plant. During the year 271 samples were analyzed for chlorides; of these, 2.2% exceeded the standard.

Table 18. Minimum, maximum, and average chloride values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERA
Zion-Benton	8	13	9
Waukegan	8	12	9
North Chicago	8	12	9
Lake Forest	8	13	10
Highland Park	8	12	9
Glencoe	8	12	9
Winnetka	8	13	10
Kenilworth	8	13	9
Wilmette	8	12	9
Evanston	8	14	9
Chicago Central	8	11	9
Chicago South	8	12	10
PCB limit:		12	

During 1968-1972, the annual average chloride levels were:

1968	9 mg/l
1969	10 mg/l
1970	9 mg/l
1971	10 mg/l
1972	9 mg/l

CYANIDE

Standard: Shall not exceed 0.01 mg/l

In 1972, a total of 269 water samples from the twelve water plants were analyze for cyanide. Detectable concentrations were not present in any of these sample Detectable concentrations of cyanide were not found during the five year period beginning in 1968.

FLUORIDE

Standard: Shall not exceed 1.4 mg/l

Fluoride concentrations were less than 1.4 mg/l at all twelve water plants. The maximum values ranged from 0.2 to 1.0 mg/l.

Table 19. Minimum, maximum and average fluoride values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.1	0.2	0.2
Waukegan	0.0	0.2	0.1
North Chicago	0.0	0.2	0.1
Lake Forest	0.0	0.2	0.2
Highland Park	0.0	0.3	0.1
Glencoe	0.0	0.2	0.1
Winnetka	0.0	1.0	0.3
Kenilworth	0.0	0.8	0.2
Wilmette	0.0	0.2	0.1
Evanston	0.0	0.2	0.1
Chicago Central	0.1	0.2	0.1
Chicago South	0.1	0.2	0.2
PCB limit:		1.4	

During 1968-1972, the annual average fluoride levels and the percent of samples in violation of the 1972 standard were:

1968	0.1 mg/l	(No violations)
1969	0.2 mg/l	(1.8%)
1970	0.1 mg/l	(No violations)
1971	0.2 mg/l	(No violations)
1972	0.1 mg/l	(No violations)

IRON (Dissolved)

The former standards for dissolved iron were eliminated under the water quality regulations adopted by the Pollution Control Board in 1972.

Data obtained in 1972 are listed in Table 20. The maximum value recorded at each water plant was 0.10 mg/l; the annual average values at these plants ranged from 0.02 to 0.04 mg/l. All of these values were within the limits of the former standards (0.30 mg/l for single values and 0.15 mg/l for annual averages).

Table 20. Minimum, maximum and average dissolved iron values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVE
Zion-Benton	0.00	0.10	0.03
Waukegan	0.00	0.10	0.03
North Chicago	0.00	0.10	0.03
Lake Forest	0.00	0.10	0.04
Highland Park	0.00	0.10	0.03
Glencoe	0.00	0.10	0.02
Winnetka	0.00	0.10	0.02
Kenilworth	0.00	0.10	0.03
Wilmette	0.00	0.10	0.03
Evanston	0.00	0.10	0.03
Chicago Central	0.00	0.10	0.02
Chicago South	0.00	0.10	0.02

Iron (total)

Standard: Shall not exceed 0.3 mg/l

In 1972, 9.5% of the samples obtained at the municipal water plants exceeded the standard. The maximum values at all twelve plants were in excess of 0.3 mg/l. These maximum values ranged from 0.4 to 2.6 mg/l.

Table 21. Minimum, maximum and average total iron values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.0	0.4	0.1
Waukegan	0.0	0.8	0.1
North Chicago	0.0	0.4	0.1
Lake Forest	0.0	1.0	0.2
Highland Park	0.0	0.6	0.2
Glencoe	0.0	0.4	0.1
Winnetka	0.0	0.4	0.1
Kenilworth	0.0	2.6	0.3
Wilmette	0.0	0.5	0.2
Evanston	0.0	0.8	0.1
Chicago Central	0.0	0.4	0.1
Chicago South	0.0	0.5	0.1
PCB limit:		0.3	

PHENOLS

Standard: Shall not exceed 0.001 mg/l

In 1972, detectable levels of phenols were found in only one sample. This sample was collected at the Chicago South water plant and had a phenol concentration of 0.027 mg/l.

During 1968-1972, phenols were found in the concentrations listed below. Percent violations, based on the 1972 standard, are in parentheses.

1968	0.003 - 0.012 mg/l	(5.8%)
1969	No detectable concentrations found	
1970	0.017 - 0.020 mg/l	(2.9%)
1971	No detectable concentrations found	
1972	0.027 mg/l	(0.3%)

SULFATE

Standard: Shall not exceed 24 mg/l

The maximum values at 10 of the water plants exceeded the standard. These high values ranged from 25 to 32 mg/l. At the other two plants the maximum values were at the limit set for sulfates. In all, 5.9% of the samples exceeded 24 mg/l.

Table 22. Minimum, maximum, and average sulfate values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	11	28	18
Waukegan	8	24	16
North Chicago	8	25	16
Lake Forest	8	27	17
Highland Park	8	25	16
Glencoe	8	24	16
Winnetka	9	25	17
Kenilworth	9	25	18
Wilmette	9	25	16
Evanston	10	26	17
Chicago Central	8	26	16
Chicago South	10	32	18
PCB limit:		24	

From 1968-1972, the annual average sulfate values were:

1968	23 mg/l
1969	21 mg/l
1970	21 mg/l
1971	23 mg/l
1972	17 mg/l

PHOSPHORUS (as P)

Standard: Shall not exceed 0.007 mg/l

Maximum phosphorus concentrations exceeded the standard at all twelve water plants. These maximum values ranged from 0.030 mg/l at the Chicago Central plant to 0.600 mg/l at the Winnetka plant. Phosphorus concentrations in 64% of the samples exceeded 0.007 mg/l.

Table 23. Minimum, maximum and average phosphorus values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.000	0.080	0.016
Waukegan	0.000	0.070	0.018
North Chicago	0.000	0.165	0.024
Lake Forest	0.000	0.450	0.074
Highland Park	0.000	0.100	0.028
Glencoe	0.000	0.067	0.019
Winnetka	0.000	0.600	0.066
Kenilworth	0.000	0.140	0.035
Wilmette	0.000	0.090	0.022
Evanston	0.000	0.350	0.042
Chicago Central	0.000	0.030	0.009
Chicago South	0.000	0.350	0.032
PCB limit:		0.007	

The revised 1972 standard and technical changes in laboratory procedures prevent yearly comparison.

TOTAL DISSOLVED SOLIDS

Standard: Shall not exceed 180 mg/l.

In 1972, 1.4% of the samples collected from municipal water plants exceeded 180 mg/l. Excessive values were recorded at the Lake Forest, Winnetka and Evanston plants.

Table 24. Minimum, maximum and average total dissolved solids recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERA
Zion-Benton	160	180	166
Waukegan	156	174	164
North Chicago	160	180	164
Lake Forest	140	186	167
Highland Park	160	180	167
Glencoe	160	180	167
Winnetka	160	186	169
Kenilworth	160	180	166
Wilmette	156	180	166
Evanston	160	186	167
Chicago Central	140	174	162
Chicago South	160	180	165
PCB limit:		180	

During 1968-1972, the annual average concentrations of dissolved solids in Lake Michigan and percent violations were:

1968	164 mg/l	(0.0%)
1969	166 mg/l	(3.5%)
1970	163 mg/l	(1.0%)
1971	166 mg/l	(5.4%)
1972	166 mg/l	(1.4%)

RADIOACTIVITY

Standards: Gross alpha concentrations shall not exceed 3 pCi/l
Gross beta concentrations shall not exceed 100 pCi/l

Gross alpha concentrations ranged from 0 to 5 pCi/l in 1972. The highest concentration was recorded at the Lake Forest water plant. The annual average concentration of all plants was less than 1 pCi/l.

RADIOACTIVITY (Continued)

The gross beta standard was not exceeded in 1972. Concentrations ranged from 0 to 16 pCi/l, with the highest concentration in a sample collected at the Chicago South water plant. The annual average concentration of all plants was 4 pCi/l.

FECAL COLIFORM

Because of program limitations the requirement that the geometric mean be based on a minimum of five samples obtained within a 30-day period could not be met in the open waters. The results from 1972 were evaluated on an annual geometric mean basis. Annual geometric mean values ranged from 1 to 4/100 ml. The maximum single counts ranged from 2/100 ml at the Chicago Central water plant to 300/100 ml at the Zion-Benton water plant.

Table 25. Minimum, maximum and geometric mean fecal coliform values obtained at water filtration plants in 1972.

(Number per 100 millititers)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL GEOMETRIC
Zion-Benton	1	300	3
Waukegan	1	6	1
North Chicago	1	160	1
Lake Forest	1	24	2
Highland Park	1	60	4
Glencoe	1	38	2
Winnetka	1	50	2
Kenilworth	1	80	3
Wilmette	1	106	2
Evanston	1	96	2
Chicago Central	1	2	1
Chicago South	1	4	1

For the period from 1968-1972, the annual geometric mean values for all plants have been uniformly low:

1968	2/100 ml	1971	2/100 ml
1969	2/100 ml	1972	2/100 ml
1970	1/100 ml		

PLANKTON

There are no standards for plankton.

The maximum plankton counts ranged from 7,000/ml at the Winnetka plant to 29,000/ml at the Lake Forest water plant. The annual averages ranged from 2900 to 5600/ml.

Table 26. Minimum, maximum and average plankton counts recorded at water filtration plants in 1972.

(Number per milliliter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERA
Zion-Benton	800	8900	3700
Waukegan	1000	7500	4000
North Chicago	500	10,300	3200
Lake Forest	300	29,000	5600
Highland Park	500	8000	3800
Glencoe	500	12,000	4500
Winnetka	100	7000	3000
Kenilworth	800	10,400	4600
Wilmette	900	8700	3700
Evanston	500	11,000	3700
Chicago Central	400	7500	2900
Chicago South	700	9000	3200

From 1968 to 1972, annual average plankton counts were:

1968	4000/ml
1969	2900/ml
1970	3000/ml
1971	3200/ml

NITRATES PLUS NITRITES (as N)

Standard: Shall not exceed 10.0 mg/l

Nitrate - Nitrite levels were uniformly low in 1972. Maximum values obtained at the twelve water plants ranged from 0.4 to 0.6 mg/l. The annual average at these plants was 0.3 mg/l.

Table 27. Minimum, maximum and average nitrate-nitrite values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	0.0	0.4	0.3
Waukegan	0.0	0.6	0.3
North Chicago	0.0	0.4	0.3
Lake Forest	0.0	0.5	0.3
Highland Park	0.0	0.4	0.3
Glencoe	0.0	0.4	0.3
Winnetka	0.0	0.4	0.3
Kenilworth	0.0	0.5	0.3
Wilmette	0.0	0.4	0.3
Evanston	0.0	0.5	0.3
Chicago Central	0.0	0.4	0.3
Chicago South	0.0	0.4	0.3
PCB limit:		10.0	

ALKALINITY

There are no standards for alkalinity.

In the aquatic environment, alkalinity serves as a buffer to prevent any abrupt change in pH of the water which might otherwise affect fish and other aquatic organisms.

The maximum values in 1972 ranged from 116 to 144 mg/l. The annual averages at the twelve plants ranged from 107 to 109 mg/l.

Table 28. Minimum, maximum and average alkalinity values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	100	116	107
Waukegan	105	144	109
North Chicago	104	136	109
Lake Forest	105	124	109
Highland Park	100	120	108
Glencoe	105	120	109
Winnetka	100	124	108
Kenilworth	100	120	109
Wilmette	105	124	109
Evanston	105	120	109
Chicago Central	100	116	108
Chicago South	104	124	108

HARDNESS

There are no standards for hardness.

The principal effect of hardness is economic. Hard water forms scales in boilers, heaters, radiators and pipes, and is responsible for increased consumption of soap and detergents. Aside from economic considerations, hard waters have been shown to reduce the detrimental effects of toxic metals on aquatic life.

The maximum values recorded at the water plants in 1972 ranged from 140 to 188 mg/l. The annual averages ranged from 131 to 134 mg/l.

Table 29. Minimum, maximum and average hardness values recorded at water filtration plants in 1972.

(Milligrams per liter)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	128	140	131
Waukegan	130	188	134
North Chicago	130	180	134
Lake Forest	125	156	134
Highland Park	125	148	132
Glencoe	125	152	133
Winnetka	125	148	134
Kenilworth	128	148	133
Wilmette	125	152	133
Evanston	125	148	132
Chicago Central	125	144	131
Chicago South	125	156	132

From 1969 to 1972, the annual average hardness values from all plants were:

1969	134 mg/l
1970	138 mg/l
1971	133 mg/l
1972	133 mg/l

ARSENIC (total)

Standard: Shall not exceed 0.01 mg/l

No detectable levels were found in 141 samples collected from the water plants.

BARIUM (total)

Standard: Shall not exceed 1.0 mg/l

No detectable levels of barium were found in 83 samples obtained from the water plants.

BORON (total)

Standard: Shall not exceed 1.0 mg/l

No detectable levels were found in 83 samples from the water plants.

CADMIUM (total)

Standard: Shall not exceed 0.01 mg/l

No detectable levels of cadmium were found in 141 samples collected at the water plants.

CHROMIUM (total hexavalent)

Standard: Shall not exceed 0.05 mg/l

No detectable levels of hexavalent chromium were found in 153 samples obtained from the water plants in 1972.

CHROMIUM (total trivalent)

Standard: Shall not exceed 1.0 mg/l

No detectable levels of trivalent chromium were found in 153 samples from the water plants in 1972.

CHROMIUM (total)

Standard: There is no standard for this parameter

No detectable levels of total chromium were found in 153 samples obtained from the water plants.

COPPER (total)

Standard: Shall not exceed 0.02 mg/l

In 1972, copper concentrations in 2.1% of the samples exceeded 0.02 mg/l. The excessive amounts, which ranged from 0.04 to 0.05 mg/l, were found at the North Chicago and Lake Forest plants. At these plants the percentage of samples in excess of 0.02 mg/l was 7.7 and 15.4%, respectively.

Table 30. Minimum, maximum and average concentrations of heavy metals recorded at water filtration plants in 1972.

(Milligrams per liter)

	MINIMUM	MAXIMUM	AVERAGE
Arsenic	0.00	0.00	0.00
Barium	0.00	0.00	0.00
Boron	0.00	0.00	0.00
Cadmium	0.00	0.00	0.00
Chromium (Hex)	0.00	0.00	0.00
Chromium (Tri)	0.00	0.00	0.00
Chromium (Total)	0.00	0.00	0.00
Copper	0.00	0.05	0.01
Iron (Total)	0.00	2.60	0.10
Iron (Dissolved)	0.00	0.10	0.03
Lead	0.00	0.00	0.00
Manganese	0.00	0.30	0.01
Mercury	0.00	0.00	0.00
Nickel	0.00	0.00	0.00
Silver	0.00	0.00	0.00
Zinc	0.00	1.00	0.03

LEAD (total)

Standard: Shall not exceed 0.05 mg/l

No detectable levels of lead were found in 153 samples collected at the water plants.

MANGANESE (total)

Standard: Shall not exceed 0.05 mg/l

A total of 165 water samples were analyzed for manganese in 1972. Four samples were found to have concentrations of manganese in excess of 0.05 mg/l. These concentrations were found at the Zion-Benton (0.06), Lake Forest (0.09), Kenilworth (0.30), and Evanston (0.07) water plants.

MERCURY

Standard: Shall not exceed 0.0005 mg/l

Of the ninety-five water samples analyzed in 1972, three had detectable levels of mercury. The mercury concentration in these samples (collected from the Winnetka, Evanston and Chicago South plants) was 0.0002 mg/l.

NICKEL (total)

Standard: Shall not exceed 1.0 mg/l

No detectable levels of nickel were found in 153 samples collected at the water plants.

SELENIUM (total)

Standard: Shall not exceed 0.01 mg/l

No detectable levels of selenium were found in 71 samples collected at the water plants.

SILVER (total)

Standard: Shall not exceed 0.005 mg/l

No detectable levels of silver were found in 119 samples collected at the water plants.

ZINC

Standard: Shall not exceed 1.0 mg/l

Of the 153 samples analyzed for zinc, none had zinc levels greater than 1.0 mg/l. One sample from Kenilworth had a concentration of 1.0 mg/l. All other values were less than 0.5 mg/l.

COLOR

Standard: Shall be free from unnatural color

Unnatural color was not observed in the open waters of Lake Michigan in 1972.

In addition to visual observations for unnatural color, water samples were analyzed for color in the laboratory. The results, expressed as numerical values, were compared to the former standards. The maximum values ranged from 5 to 12 units, and the anuual averages were within the limits of the former standard.

Table 31. Minimum, maximum and average color values recorded at water treatment plants in 1972.

(Units)

WATER FILTRATION PLANT	MINIMUM	MAXIMUM	ANNUAL AVERAGE
Zion-Benton	1	8	4
Waukegan	1	6	4
North Chicago	1	7	3
Lake Forest	2	5	3
Highland Park	2	12	4
Glencoe	2	7	4
Winnetka	2	12	4
Kenilworth	2	7	4
Wilmette	1	7	3
Evanston	2	7	3
Chicago Central	2	5	3
Chicago South	2	6	4
Former limits:		15	5

WATER QUALITY MONITORING

BOAT SAMPLING

TOTAL COLIFORM

There is no present standard for total coliform bacteria. None of the maximum values exceeded the former standard of 2,500/100 ml. The former annual average standard was exceeded at the Chicago-Montrose Harbor surface station.

Table 32. Maximum and average total coliform counts recorded 5 miles offshore in Lake Michigan in 1972

(Counts per 100 milliliters)

STATION	Surface		Mid-Depth		Bottom	
	Maximum	Average	Maximum	Average	Maximum	Average
Illinois-Wisconsin State Line	380	79	16	6	250	51
Waukegan	100	25	200	42	56	14
Lake Bluff	52	15	20	11	5	2
Highland Park	22	6	70	19	100	23
Wilmette	90	25	72	24	48	24
Chicago-Montrose Harbor	2300	463	350	79	50	20
Chicago-Burnham Harbor	190	43	140	34	110	33
Illinois-Indiana State Line	290	70	200	61	500	144
Former Standards:	2,500	200	2,500	200	2,500	200

FECAL STREPTOCOCCI

There is no present standard for fecal streptococci. The results from 1972 were compared to the former standard of 25/100 ml.

The fecal streptococci counts in one surface, mid-depth and bottom sample exceeded 25/100 ml. These samples constituted 2.5% of the total samples analyzed for fecal streptococci in 1972.

Table 33. Maximum and average fecal streptococci counts recorded 5 miles offshore in Lake Michigan in 1972.

(Counts per 100 milliliters)

STATION	Surface		Mid-Depth		Bott
	Maximum	Average	Maximum	Average	Maximum
Illinois-Wisconsin State Line	6	2	2	1	6
Waukegan	1	1	110	25	4
Lake Bluff	5	2	5	2	40
Highland Park	5	2	6	3	22
Wilmette	164	34	16	4	2
Chicago-Montrose Harbor	2	1	4	2	6
Chicago-Burnham Harbor	1	1	1	1	4
Illinois-Indiana State Line	1	1	4	2	1
Former Standard	25		25		25

TURBIDITY

Standard: Shall be free from unnatural turbidity

No unnatural turbidity was observed at the 5-mile stations in 1972.

Laboratory analyses for turbidity were conducted on water samples collected at the 5 mile stations. Results summarized below show turbidity levels to be quite low compared to the values obtained from the water plants, (page 22).

Table 34. Maximum and average turbidity values recorded 5 miles offshore in Lake Michigan in 1972.

(JTU)

STATION	Surface		Mid-Depth		Bott
	Maximum	Average	Maximum	Average	Maximum
Illinois-Wisconsin State Line	3	2	3	1	3
Waukegan	3	2	3	1	3
Lake Bluff	3	2	3	2	5
Highland Park	5	3	5	3	5
Wilmette	3	2	4	3	4
Chicago-Montrose Harbor	3	1	3	2	3
Chicago-Burnham Harbor	3	1	3	2	5
Illinois-Indiana State Line	3	1	3	2	3

ODOR

Standard: Shall be free from odor

There were no significant odors present in the open water samples.

VISIBLE OIL

Standard: Shall be free from visible oil

Water samples from the eight lake stations did not contain visible oil.

FLOATING DEBRIS

Standard: Shall be free from floating debris

Floating debris was not observed at the 5-mile lake stations in 1972.

TEMPERATURE

Standard: Shall not exceed the maximum limits (°F) indicated in the following table:

JUN.	JUL.	AUG.	SEPT.	OCT.
70	80	80	80	65

None of the recorded temperatures exceeded the maximum limits outlined in the standard. The maximum monthly temperatures recorded at the 5-mile stations in 1972 are summarized in Table 35. The average surface, mid-depth and bottom temperatures at the eight stations, together with the temperature range at these stations, is presented in Table 36.

Table 35. Maximum monthly temperatures recorded 5 miles offshore in Lake Michigan in 1972.

(Degrees Fahrenheit)

MONTHLY MAXIMUM (°F)	Surface	Mid-Depth	Bottom
JUNE (70)	59	58	58
JULY (80)	67	61	51
AUGUST (80)	73	72	71
SEPTEMBER (80)	67	64	62
OCTOBER (65)	52	50	51

Table 36. Minimum, maximum and average temperatures recorded 5 miles offshore in Lake Michigan in 1972.

(Degrees Fahrenheit)

STATION	Surface		Mid-Depth		Bottom	
	Range	Average	Range	Average	Range	Avera
Illinois-Wisconsin State Line	45-71	57	43-62	51	41-51	46
Waukegan	45-72	58	44-63	53	43-50	47
Lake Bluff	46-67	59	46-57	53	49-55	52
Highland Park	47-67	59	47-67	57	47-67	54
Wilmette	47-66	57	47-65	56	47-57	52
Chicago-Montrose Harbor	47-53	59	47-71	59	47-65	54
Chicago-Burnham Harbor	50-72	61	49-71	60	49-65	58
Illinois-Indiana State Line	52-72	62	50-72	59	51-71	59

pH

Standard: Shall be within the range of 7.0 to 9.0 except for natural causes

In 1972, pH levels were within the prescribed limits. Table 37 summarizes the data obtained from the eight lake stations.

Table 37. Minimum, maximum and average pH values recorded 5 miles offshore in Lake Michigan in 1972.

(pH Units)

STATION	Surface		Mid-Depth		Bottom
	Range	Avg.	Range	Avg.	Range
Illinois-Wisconsin State Line	8.2-8.6	8.4	8.2-8.4	8.3	8.2-8.3
Waukegan	8.2-8.7	8.5	8.0-8.4	8.3	8.2-8.6
Lake Bluff	8.0-8.4	8.3	7.2-8.4	8.1	8.0-8.3
Highland Park	7.8-8.6	8.3	7.3-9.0	8.3	7.1-8.5
Wilmette	7.7-8.5	8.3	7.5-8.6	8.3	8.2-8.5
Chicago-Montrose Harbor	8.0-8.6	8.4	7.6-8.5	8.3	7.6-8.5
Chicago-Burnham Harbor	8.1-8.6	8.4	7.4-8.6	8.2	7.4-8.5
Illinois-Indiana State Line	8.0-8.5	8.3	7.4-8.5	8.2	8.0-8.5

DISSOLVED OXYGEN

Standard: Shall not be less than 90% of saturation except due to natural causes

In 1972, 24.7% of the samples collected from the eight lake stations had dissolved oxygen levels less than 90% saturation. All except one of these samples were obtained in September and October. The percentage of surface, mid-depth and bottom samples with D.O. levels less than 90% saturation were 26, 26 and 48%, respectively. The higher incidence of reduced D.O. in the bottom samples results from the formation of thermoclines following the spring overturn.

Table 38. Minimum, maximum and average dissolved oxygen values recorded 5 miles offshore in Lake Michigan in 1972.

(Percent Saturation)

	Surface		Mid-Depth		Bottom	
STATION	Range	Average	Range	Average	Range	Average
Illinois-Wisconsin State Line	82-120	103	82-101	93	89-102	94
Waukegan	83-113	101	93-103	99	85-104	95
Lake Bluff	84-115	101	92-103	97	89-104	99
Highland Park	76-108	97	87-108	100	88-108	98
Wilmette	94-107	101	91-98	94	80-98	88
Chicago-Montrose Harbor	85-106	97	76-104	94	76-99	89
Chicago-Burnham Harbor	88-107	98	78-105	96	78-102	93
Illinois-Indiana State Line	90-108	99	80-107	94	80-100	91

AMMONIA NITROGEN (as N)

Standard: Shall not exceed 0.02 mg/l

In 1972, the ammonia nitrogen concentration in 105 of 120 samples (87.5%) exceeded 0.02 mg/l. For each station the percentage of samples exceeding the standard ranged from 60 to 100%. Violations were evenly distributed between surface, mid-depth and bottom locations. The concentration range of ammonia nitrogen and the annual averages are summarized in Table 39.

Table 39. Minimum, maximum and average ammonia (N) values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

STATION	Surface		Mid-Depth		Bottom	
	Range	Avg.	Range	Avg.	Range	A
Illinois-Wisconsin State Line	0.01-0.20	0.06	0.05-0.20	0.12	0.05-0.20	0
Waukegan	0.02-0.40	0.11	0.02-0.10	0.07	0.01-0.20	0
Lake Bluff	0.05-0.20	0.10	0.05-0.10	0.06	0.05-0.10	0
Highland Park	0.02-0.20	0.08	0.05-0.10	0.07	0.02-0.20	0
Wilmette	0.05-0.20	0.10	0.02-0.10	0.07	0.05-0.20	0
Chicago-Montrose Harbor	0.04-0.20	0.10	0.05-0.12	0.08	0.05-0.12	0
Chicago-Burnham Harbor	0.02-0.05	0.04	0.02-0.10	0.07	0.02-0.20	0
Illinois-Indiana State Line	0.03-1.00	0.26	0.07-0.20	0.15	0.02-0.20	0

METHYLENE BLUE ACTIVE SUBSTANCE (MBAS)

Standard: Shall not exceed 0.5 mg/l

The concentrations of MBAS in the 120 samples analyzed were 0.2 mg/l or less at all stations. There were no significant depth-dependent differences.

CHLORIDE

Standard: Shall not exceed 12 mg/l

Chloride levels did not exceed the standard at the eight lake stations in 1972. There were no significant differences at the surface, mid-depth and bottom locations.

Table 40. Minimum, maximum and average chloride values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

STATION	Surface		Mid-Depth		Bottom	
	Range	Average	Range	Average	Range	Av
Illinois-Wisconsin State Line	8-10	9	8-9	8	8-8	
Waukegan	8-8	8	8-11	9	8-10	
Lake Bluff	8-9	9	8-9	9	8-9	
Highland Park	8-9	9	8-9	9	8-9	
Wilmette	8-9	9	8-9	9	8-9	
Chicago-Montrose Harbor	8-10	9	8-10	9	8-10	
Chicago-Burnham Harbor	8-9	9	8-9	9	8-9	
Illinois-Indiana State Line	8-9	9	8-9	9	8-9	

CYANIDE

Standard: Shall not exceed 0.01 mg/l

No detectable concentrations of cyanide were found in 120 samples from the lake stations.

FLUORIDE

Standard: Shall not exceed 1.4 mg/l

The maximum fluoride concentration at each station was 0.2 mg/l. Significant differences between the surface, mid-depth and bottom stations were not observed in 1972.

PHENOLS

Standard: Shall not exceed 0.001 mg/l

No detectable levels of phenols were found in 120 samples from the lake stations.

SULFATE

Standard: Shall not exceed 24 mg/l

In 1972, one surface and one mid-depth sample exceeded 24 mg/l. These two samples constitute 1.6% of the samples analyzed for sulfates.

Table 41. Minimum, maximum and average sulfate values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligram per liter)

	Surface		Mid-Depth		Bottom	
STATION	Range	Average	Range	Average	Range	Average
Illinois-Wisconsin State Line	10-19	15	13-15	14	10-15	12
Waukegan	9-15	12	9-19	13	9-15	12
Lake Bluff	10-23	15	9-20	14	10-18	13
Highland Park	10-15	13	10-22	14	9-20	14
Wilmette	8-16	12	8-17	12	9-15	11
Chicago-Montrose Harbor	8-29	17	8-29	17	9-23	16
Chicago-Burnham Harbor	6-18	12	9-22	14	8-18	12
Illinois-Indiana State Line	9-13	11	8-18	13	10-15	13

PHOSPHORUS (as P)

Standard: Shall not exceed 0.007 mg/l

The phosphorus concentration in 49 of 120 samples exceeded 0.007 mg/l. The percentages of violations at the surface, mid-depth and bottom locations were 30.6, 34.7 and 34.7%, respectively. The highest concentrations were found at the surface stations, and the lowest at the bottom locations.

Table 42. Maximum and average phosphorus values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

	Surface		Mid-Depth		Bottom	
STATION	Maximum	Average	Maximum	Average	Maximum	Av
Illinois-Wisconsin State Line	0.250	0.053	0.120	0.035	0.017	0
Waukegan	0.260	0.052	0.020	0.004	0.070	0
Lake Bluff	0.540	0.110	0.170	0.037	0.850	0
Highland Park	2.100	0.844	1.100	0.225	0.300	0
Wilmette	9.600	1.939	0.400	0.084	0.018	0
Chicago-Montrose Harbor	0.040	0.008	0.040	0.008	0.010	0
Chicago-Burnham Harbor	0.260	0.059	3.300	0.662	0.220	0
Illinois-Indiana State Line	0.010	0.004	3.400	0.684	0.040	0

TOTAL DISSOLVED SOLIDS

Standard: Shall not exceed 180 mg/l

The concentrations of dissolved solids were within the standard in 1972. The maximum values recorded at the eight stations ranged from 162 to 170 mg/l.

RADIOACTIVITY

Standards: Gross alpha concentrations shall not exceed 3 pCi/l
Gross beta concentrations shall not exceed 100 pCi/l

Gross alpha concentrations ranged from 0 to 2 pCi/l at the 5-mile stations in 1972. The highest concentration was recorded in a surface sample collected at the Wilmette station. The annual average concentration of all stations was less than 1 pCi/l.

The gross beta standard was not exceeded in 1972. Concentrations ranged from 0 to 8 pCi/l; the highest concentration was obtained from a bottom sample collected at the Waukegan station. The annual average concentration of all stations was 4 pCi/l.

Table 43. Maximum and average total dissolved solids values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

STATION	Surface		Mid-Depth		Bottom	
	Maximum	Average	Maximum	Average	Maximum	Average
Illinois-Wisconsin State Line	170	162	170	162	162	160
Waukegan	162	160	162	160	162	160
Lake Bluff	170	162	170	164	170	164
Highland Park	170	164	170	164	170	164
Wilmette	170	162	162	160	170	162
Chicago-Montrose Harbor	162	160	170	162	170	162
Chicago-Burnham Harbor	162	160	170	164	170	162
Illinois-Indiana State Line	170	164	170	164	170	162

FECAL COLIFORM

Standard: Based on a minimum of five samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 20 per 100 ml

The geometric mean values discussed in this section are annual geometric means. In 1972, the annual geometric means were uniformly low with a range from 1 to 3/100 ml. The highest single values at the surface, mid-depth and bottom locations were 400, 240 and 200/100 ml, respectively.

Table 44. Maximum and geometric mean fecal coliform counts recorded 5 miles offshore in Lake Michigan in 1972.

(Counts per 100 milliliters)

STATION	Surface		Mid-Depth		Bottom	
	Maximum	Geom. Mean	Maximum	Geom. Mean	Maximum	Geo. Mean
Illinois-Wisconsin State Line	4	1	1	1	6	1
Waukegan	2	1	16	2	1	1
Lake Bluff	6	1	1	1	1	1
Highland Park	1	1	2	1	1	1
Wilmette	1	1	1	1	1	1
Chicago-Montrose Harbor	400	3	2	1	1	1
Chicago-Burnham Harbor	1	1	2	1	1	1
Illinois-Indiana State Line	6	2	240	3	200	3

PLANKTON

There is no standard for plankton. Analyses were conducted on 119 samples from the lake stations; the results are summarized in Table 45. The plankton populations were slightly higher at the mid-depth and bottom locations, averaging 3400 and 3100 ml, respectively, compared with the surface population average of 2900/ml.

Table 45. Minimum, maximum and average plankton counts recorded 5 miles offshore in Lake Michigan in 1972.

(Numbers per milliliter)

STATION	Surface		Mid-Depth		Bot
	Range	Average	Range	Average	Range
Illinois-Wisconsin State Line	1500-3700	2800	1300-3700	2800	1200-3300
Waukegan	1400-3300	2300	1200-3900	2500	1100-4500
Lake Bluff	1200-5600	3800	1500-6000	3800	1600-6900
Highland Park	1200-6000	3400	900-6700	4100	1200-7200
Wilmette	900-3500	2100	1900-5400	3400	800-5600
Chicago-Montrose Harbor	1700-4300	3300	1900-5000	3300	1800-5800
Chicago-Burnham Harbor	1100-5000	2900	1400-6900	3600	1800-6100
Illinois-Indiana State Line	1300-5100	3300	1400-7300	3400	1200-5700

SECCHI DISC

There is no standard for this parameter. The minimum, as well as the maximum, visibilities were recorded at the southern end of the lake. Average Secchi disc readings ranged from 12 to 17 feet.

Table 46. Minimum, maximum and average Secchi disc readings recorded 5 miles offshore in Lake Michigan in 1972.

(Depth in Feet)

STATION	Minimum	Maximum	Average
Illinois-Wisconsin State Line	11	16	14
Waukegan	12	17	14
Lake Bluff	9	16	12
Highland Park	10	17	13
Wilmette	11	14	13
Chicago-Montrose Harbor	14	22	17
Chicago-Burnham Harbor	8	20	15
Illinois-Indiana State Line	8	22	14

NITRATES PLUS NITRITES (as N)

Standard: Shall not exceed 10.0 mg/l

Nitrate-nitrite analyses were conducted on 120 samples in 1972; all values were 0.4 mg/l or less. There were no significant differences at the surface, mid-depth and bottom stations.

ALKALINITY

There is no standard for this parameter. There appeared to be greater variability in alkalinity levels at the mid-depth and bottom stations than at the surface. The maximum difference in surface values at any one station was 10 mg/l; comparable differences were 34 mg/l at the mid-depth locations and 22 mg/l at the bottom stations.

Table 47. Maximum, minimum and average alkalinity values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

	Surface		Mid-Depth		Bottom	
STATION	Range	Average	Range	Average	Range	Average
Illinois-Wisconsin State Line	104-105	105	104-105	105	100-108	105
Waukegan	104-105	105	105-108	106	100-108	105
Lake Bluff	104-105	105	90-110	104	100-110	106
Highland Park	100-110	106	94-120	106	88-108	102
Wilmette	100-110	106	100-110	106	105-110	108
Chicago-Montrose Harbor	105-110	107	76-110	100	90-110	104
Chicago-Burnham Harbor	105-108	106	88-110	103	86-108	102
Illinois-Indiana State Line	100-110	106	96-108	104	100-108	105

HARDNESS

There is no standard for this parameter. In 1972, 120 samples from the lake stations were analyzed for hardness. The results are summarized in Table 48. There was no significant difference in hardness levels at the various locations.

Table 48. Minimum, maximum and average hardness values recorded 5 miles offshore in Lake Michigan in 1972.

(Milligrams per liter)

STATION	Surface		Mid-Depth		Bottom	
	Range	Average	Range	Average	Range	Av
Illinois-Wisconsin State Line	124-130	129	128-130	130	128-130	
Waukegan	128-130	130	128-130	130	128-130	
Lake Bluff	128-135	131	128-135	131	128-135	
Highland Park	130-150	135	130-135	131	130-135	
Wilmette	130-135	131	130-135	131	130-130	
Chicago-Montrose Harbor	130-130	130	130-130	130	130-130	
Chicago-Burnham Harbor	130-130	130	130-135	131	130-135	
Illinois-Indiana State Line	130-130	130	130-150	134	130-135	

ARSENIC (total)

Standard: Shall not exceed 0.01 mg/l

In 1972, only one out of 96 samples analyzed for arsenic yielded positive results. A surface sample collected at the Waukegan 5-mile station had an arsenic concentration of 0.004 mg/l.

BARIUM (total)

Standard: Shall not exceed 1.0 mg/l

A total of 120 samples were analyzed for barium during the year; none exceeded the standard. Detectable levels of barium were found only once from a bottom sample collected at the Illinois-Wisconsin State Line station. The barium concentration in this sample was 0.1 mg/l.

BORON (total)

Standard: Shall not exceed 1.0 mg/l

Detectable levels of boron were found in only two of 120 samples analyzed; none exceeded the standard. One sample, collected from the bottom at the Illinois-Wisconsin State Line, had a boron concentration of 0.1 mg/l. The second sample, also with a boron level of 0.1 mg/l, was collected from the bottom at the Illinois-Indiana State Line.

CADMIUM (total)

Standard: Shall not exceed 0.01 mg/l

No detectable levels of cadmium were found in 120 samples analyzed in 1972.

CHROMIUM (total hexavalent)

Standard: Shall not exceed 0.05 mg/l

No detectable levels of hexavalent chromium were found in a total of 120 samples from the eight lake stations.

CHROMIUM (total trivalent)

Standard: Shall not exceed 1.0 mg/l

No detectable levels of trivalent chromium were found in 1972.

CHROMIUM (total)

Standard: None

No detectable levels of total chromium were found in 1972.

COPPER (total)

Standard: Shall not exceed 0.02 mg/l

Copper concentrations in excess of 0.02 mg/l were found in 22.5% of the samples analyzed in 1972. The percent of violations at the surface, mid-depth and bottom locations were 37.0, 33.3 and 29.7%, respectively. The corresponding maximum values were 0.60, 1.10 and 1.80 mg/l.

IRON (total)

Standard: Shall not exceed 0.3 mg/l

Detectable concentrations of total iron were found in seven out of 120 samples analyzed. All results were 0.2 mg/l or less.

IRON (dissolved)

Standard: None

Dissolved iron concentrations of 0.02 mg/l were recorded twice in the samples collected at the eight lake stations; detectable concentrations were not found in the 118 other samples.

LEAD (total)

Standard: Shall not exceed 0.05 mg/l

No detectable levels of lead were found in 120 samples analyzed in 1972.

MANGANESE (total)

Standard: Shall not exceed 0.05 mg/l

In 1972, one out of 120 samples analyzed for manganese exceeded the standard. This sample, collected at the Wilmette mid-depth station, had a manganese concentration of 0.22 mg/l. Detectable levels of manganese were found in 10 other samples; all values were 0.04 mg/l or less.

MERCURY

Standard: Shall not exceed 0.0005 mg/l

Detectable concentrations of mercury were found in 25 out of 120 samples analyzed in 1972. All values were within the standard. The concentrations ranged from 0.0001 to 0.0005 mg/l.

NICKEL

Standard: Shall not exceed 1.0 mg/l

No detectable concentrations of nickel were found at the lake stations in 1972.

SELENIUM (total)

Standard: Shall not exceed 0.01 mg/l

No detectable levels of selenium were found in 96 samples analyzed in 1972.

SILVER (total)

Standard: Shall not exceed 0.005 mg/l

No detectable levels of silver were found in 120 samples analyzed in 1972.

ZINC

Standard: Shall not exceed 1.0 mg/l

During the year, 120 samples were analyzed for zinc; all values were 1.0 mg/l or less. The zinc concentrations at the mid-depth and bottom stations were slightly higher than the comparable surface concentrations.

Table 49. Heavy metal concentrations from water samples collected 5 miles offshore in Lake Michigan in Illinois in 1972.

(Milligrams per liter)

	MINIMUM	MAXIMUM	AVERAGE
Arsenic	0.00	0.00	0.00
Barium	0.00	0.10	0.00
Boron	0.00	0.10	0.00
Cadmium	0.00	0.00	0.00
Chromium (Hex)	0.00	0.00	0.00
Chromium (Tri)	0.00	0.00	0.00
Chromium (Total)	0.00	0.00	0.00
Copper	0.00	1.80	0.09
Iron (Total)	0.00	0.20	0.00
Iron (Dissolved)	0.00	0.02	0.00
Lead	0.00	0.00	0.00
Manganese	0.00	0.22	<0.01
Mercury	0.00	0.00	0.00
Nickel	0.00	0.00	0.00
Selenium	0.00	0.00	0.00
Silver	0.00	0.00	0.00
Zinc	0.00	1.00	0.20

COLOR

Standard: Shall be free from unnatural color

No visual observations of unnatural color were found in 1972.

Laboratory analyses for color are summarized in Table 50. The surface, mid-depth and bottom values at the four southern stations were slightly higher than those at the other stations.

Table 50. Maximum and average color values recorded 5 miles offshore in Lake Michigan in 1972.

(Units)

	Surface		Mid-Depth		Bottom	
STATION	Maximum	Avg.	Maximum	Avg.	Maximum	Avg.
Illinois-Wisconsin State Line	3	2	3	2	3	2
Waukegan	2	2	3	2	2	2
Lake Bluff	3	2	6	3	6	3
Highland Park	7	3	3	2	6	4
Wilmette	6	3	5	2	4	3
Chicago-Montrose Harbor	7	3	11	5	8	4
Chicago-Burnham Harbor	8	3	8	4	7	3
Illinois-Indiana State Line	8	4	6	4	11	4
Former Limits:	15	5	15	5	15	5

WATER QUALITY MONITORING

CALUMET HARBOR

TURBIDITY

General Standard: Shall be free from unnatural turbidity

Unnatural turbidity was not observed in 1972.

The highest turbidities recorded at the State Line and Calumet River Mouth stations were 3 and 4 JTU, respectively.

Average turbidities (JTU) from 1969 to 1972 are summarized below.

	State Line	Calumet River Mouth
1969	6	6
1970	5	6
1971	5	5
1972	2	3

ODOR

General Standard: Shall be free from odor

No detectable odors were recorded in 1972.

From 1969 to 1972, no significant odors were present in water samples collected from the State Line and Calumet River Mouth stations.

VISIBLE OIL

General Standard: Shall be free from visible oil

Visible oil was not observed at the two Calumet Harbor stations in 1972.

During the period from 1969 to 1972, oil slicks were found at the State Line station during three of four cruises in 1969, on one of three cruises in 1970 and on two of three occasions in 1971. At the Calumet River Mouth station visible oil was observed once in 1969 and twice in 1971.

FLOATING DEBRIS

General Standard: Shall be free from floating debris

Floating debris was not found within the Calumet Harbor basin in 1972.

From 1969 to 1972, 15 cruises were made to the two Calumet Harbor stations. During this period floating debris was recorded only at the State Line station. At this station sightings of floating debris were made on two of four cruises in 1969, and on one of three cruises in 1970.

TEMPERATURE

General Standard: Shall not exceed 90°F for the months of May through November (the months covered by monitoring)

On the basis of the general standard, no temperature violations were recorded in 1972. These temperatures were also within the limits of the Lake Michigan standard.

From 1969 to 1972, no violations of the general standard occurred; however, considered on the basis of the stricter Lake Michigan standard, the October temperature limit of 65°F was exceeded in 1969 (78°F) and 1970 (66°F) at the State Line station and in 1969 (68°F) at the Calumet River Mouth station.

pH

General Standard: Shall be within the range of 6.5 to 9.0 except for natural causes

In 1972, the pH levels at the two Calumet Harbor stations were within the limits of the general standard. Values ranged from 7.9 to 8.5 at the State Line station and from 7.7 to 8.5 at the Calumet River Mouth station. These values were also within the Lake Michigan pH standard (7.0 to 9.0)

From 1969 to 1972, only one pH value exceeded the pH limit. In 1969, a sample collected at the State Line station had a pH of 9.2. During this 4-year period, the annual pH averages were fairly uniform; the averages at the State Line station were all 8.3 while those at the Calumet River Mouth station ranged from 8.0 to 8.3.

DISSOLVED OXYGEN

General Standard: Shall not be less than 6.0 mg/l during at least 16 hours of any 24 hour period, nor less than 5.0 mg/l at any time.

There were no violations of the general standard in 1972. The D.O. values at the State Line station ranged from 8.0 to 10.0 mg/l, and from 8.6 to 10.0 mg/l at the Calumet River Mouth station.

On the basis of the Lake Michigan standard, which requires that the D.O. shall not be less than 90% saturation, the September 1972 value of 82% saturation at the State Line station fell below the standard. Dissolved oxygen values at the State Line station ranged from 82 to 105% saturation and from 92 to 101% saturation at the Calumet River Mouth station.

From 1969 to 1972, four D.O. values were below 90% saturation at the State Line station. These lowered D.O. levels, which ranged from 82 to 86% saturation, were recorded once in 1969, on two of three occasions in 1971 and once in 1972. At the Calumet River Mouth station D.O. values below 90% saturation were recorded on five occasions from 1969 to 1972. These levels, ranging from 69 to 89% saturation, were recorded twice in 1969, once in 1970 and twice in 1971.

AMMONIA NITROGEN (as N)

General Standard: Shall not exceed 1.5 mg/l

None of the ammonia nitrogen values from the Calumet Harbor stations exceeded the general standard in 1972. The maximum values at the State Line and Calumet River Mouth stations were 0.20 and 0.25 mg/l, respectively. However, all of the 1972 values exceeded the Lake Michigan standard (0.02 mg/l).

The highest concentration recorded in the 4 years from 1969 to 1972 was 0.33 mg/l, and was recorded at the Calumet River Mouth station. During this period ammonia nitrogen concentrations did not exceed 1.5 mg/l. However, 50% of the samples from the State Line station had ammonia nitrogen concentrations above 0.02 mg/l. At the Calumet River Mouth station this figure was 69.2%.

MBAS

Public and Food Processing Water Supply Standard: Shall not exceed 0.5 mg/l

There is no general standard for MBAS; the above value of 0.5 mg/l is applicable to Lake Michigan.

The concentrations of MBAS within the harbor were fairly low. The maximum concentration at both stations was 0.25 mg/l.

The highest value recorded at the State Line station during 1969-1972 was 0.30 mg/l (1969); the comparable figure at the Calumet River station was 0.25 mg/l (1972).

CHLORIDE

General Standard: Shall not exceed 500 mg/l

The chloride levels at the two harbor stations were well within the general standard for chlorides. These levels ranged from 8 to 10 mg/l at the State Line station and from 9 to 12 mg/l at the Calumet River Mouth station.

From 1969 to 1972, the highest chloride values obtained from these two stations were 12 and 32 mg/l, respectively.

CHLORIDE (Continued)

On the basis of the Lake Michigan standard for chlorides (12 mg/l), only the 1969 value of 32 mg/l was higher.

CYANIDE

General Standard: Shall not exceed 0.025 mg/l

No detectable concentrations of cyanide were found in 1972.

In 1971, a cyanide concentration of 0.08 mg/l, which exceeded both the general and Lake Michigan standards, was recorded in a sample from the Calumet River Mouth station.

FLUORIDE

General Standard: Shall not exceed 1.4 mg/l

Fluoride levels were uniformly low in 1972. The concentrations at the State Line station ranged from 0.1 to 0.2 mg/l and from 0.2 to 0.3 mg/l at the Calumet River Mouth station.

Data available from 1969 through 1972 from the State Line station indicate that the maximum fluoride value recorded at this station was 0.3 mg/l. At the Calumet River Mouth station, where data are available since 1970, the highest value recorded, 2.0 mg/l, exceeded the standard.

PHENOLS

General Standard: Shall not exceed 0.1 mg/l

No detectable concentrations of phenols were found within the Calumet Harbor basin in the 4-year period from 1969 to 1972.

SULFATE

General Standard: Shall not exceed 500 mg/l

Based on the general standard, sulfate concentrations were very low in 1972. The highest values at the State Line and Calumet River Mouth stations were 17 and 20 mg/l, respectively.

The highest value recorded was 39 mg/l within the Calumet Harbor basin during the 1969-1972 period.

During this period, based on the Lake Michigan standard of 24 mg/l, one sample from the State Line station (36 mg/l in 1970) and two from the Calumet River Mouth station (25 mg/l in 1969 and 39 mg/l in 1970) exceeded the Lake Michigan standard.

PHOSPHORUS

Lake Michigan Standard: Shall not exceed 0.007 mg/l

There is no general standard for phosphorus. Seven of 10 samples contained high levels of phosphorus. These values ranged from 0.017 to 0.800 mg/l at the State Line station and from 0.010 to 0.060 mg/l at the Calumet River Mouth station. The corresponding annual averages at these two stations were 0.199 and 0.020 mg/l.

Changes in the standard and in laboratory procedures precluded phosphorus comparisons with prior years.

TOTAL DISSOLVED SOLIDS

General Standard: Shall not exceed 1000 mg/l

The levels of dissolved solids within the Calumet Harbor basin were considerably lower than the general standard. In 1972, the highest values recorded at the State Line and Calumet River Mouth stations were 170 and 180 mg/l, respectively.

From 1969 to 1972, the maximum recorded values at these two stations were 178 and 180 mg/l, respectively.

The more strict Lake Michigan standard of 180 mg/l was not exceeded during the years from 1969 to 1972.

RADIOACTIVITY

General Standards: Gross Alpha emitters shall not exceed 3 pCi/l
Gross Beta emitters shall not exceed 100 pCi/l

Gross alpha concentrations ranged from 0 to 2 pCi/l in 1972. The highest concentration was recorded at the State Line station. The annual average concentration of both stations was less than 1 pCi/l.

The gross beta standard was not exceeded in 1972. Concentrations ranged from 2 to 7 pCi/l; the highest concentration was recorded at the Calumet River mouth station. The annual average concentration of both stations was 4 pCi/l.

FECAL COLIFORM

General Standard: Based on a minimum of five samples taken over not more than a 30-day period, fecal coliforms shall not exceed a geometric mean of 200 per 100 ml, nor shall more than 10% of the samples during any 30-day period, exceed 400 per 100 ml

FECAL COLIFORM (Continued)

The requirement that the geometric mean be based on a minimum of five samples collected within a 30-day period could not be met due to program limitations. The data were evaluated on an annual geometric mean basis.

In 1972, the annual geometric means at the State Line and Calumet River Mouth stations were 9 and 15/100 ml, respectively. The corresponding maximum counts at these two stations,,20 and 70/100 ml, were well below the limit of 400/100 ml.

During 1969-1972, the highest annual geometric mean recorded within Calumet Harbor was 80/100 ml, which was recorded at the Calumet River Mouth station in 1969. The highest fecal coliform count recorded at this station during this period was 170/100 ml. The corresponding value at the State Line station was 110/100 ml. Both values were recorded in 1969.

PLANKTON

There is no standard for this parameter. In 1972, plankton densities ranged from 1900 to 4000/ml at the State Line station and from 2200 to 4400/ml at the Calumet River Mouth station. The annual averages at these two stations were 3700 and 3200/ml, respectively.

SECCHI DISC

There is no standard for this parameter. Secchi disc data from 1970 through 1972 are summarized below (data in feet).

	State Line		Calumet River Mouth	
	Range	Average	Range	Average
1970	4 - 4	4	6 - 9	8
1971	6 - 8	7	6 - 6	6
1972	6 - 9	8	5 - 9	6

NITRATES PLUS NITRITES

Public and Food Processing Water Standard: Shall not exceed 10.0 mg/l

There is no general standard for this parameter. The nitrate-nitrite standard applicable to Lake Michigan was used in the evaluation of the Calumet Harbor data.

Nitrate-nitrite concentrations were very low in 1972. The range of values at the State Line station was 0.2 to 0.3 mg/l; the corresponding range at the Calumet River Mouth station was 0.2 to 0.4 mg/l.

Data from prior years are not available.

ARSENIC (total)

General Standard: Shall not exceed 1.0 mg/l

Four samples from each of the Calumet Harbor stations were analyzed for arsenic in 1972. In July an arsenic concentration of 0.08 mg/l was found in a sample from the Calumet River Mouth station. While this value did not exceed the general standard, it was above the limit of 0.01 mg/l applicable to Lake Michigan.

BARIUM (total)

General Standard: Shall not exceed 5.0 mg/l

No detectable levels of barium were found in 10 samples analyzed in 1972.

BORON (total)

General Standard: Shall not exceed 1.0 mg/l

Detectable concentrations of boron were found in one of 10 samples in 1972. A boron concentration of 0.1 mg/l was found at the Calumet River Mouth station during the September cruise.

CADMIUM (total)

General Standard: Shall not exceed 0.05 mg/l

No detectable concentrations of cadmium were found in 10 samples analyzed in 1972.

CHROMIUM (total hexavalent)

General Standard: Shall not exceed 0.05 mg/l

No detectable levels of total hexavalent chromium were found in ten samples collected in 1972.

CHROMIUM (total trivalent)

General Standard: Shall not exceed 1.0 mg/l

No detectable concentrations of trivalant chromium were found in 10 samples obtained from within the Calumet Harbor basin.

CHROMIUM (total)

There is no standard for this parameter. No detectable concentrations were found in the 10 samples analyzed in 1972.

COPPER (total)

General Standard: Shall not exceed 0.02 mg/l

Three of 10 samples analyzed for copper had concentrations above 0.02 mg/l. Two of these, 0.05 and 0.30 mg/l, were from the State Line station and one, 0.50 mg/l, was recorded at the Calumet River Mouth station.

IRON (total)

General Standard: Shall not exceed 1.0 mg/l

None of the 10 samples exceeded 1.0 mg/l. The highest recorded values were 0.1 and 0.2 mg/l from the State Line and Calumet River Mouth stations, respectively. These values were also below the standard of 0.3 mg/l applicable to Lake Michigan.

IRON (dissolved)

There is no standard for dissolved iron. Ten samples were analyzed for dissolved iron in 1972. Detectable concentrations were found in one sample (0.1 mg/l from the State Line station) during the September cruise.

LEAD (total)

General Standard: Shall not exceed 0.1 mg/l

No detectable levels of lead were found in 10 samples analyzed in 1972.

MANGANESE (total)

General Standard: Shall not exceed 1.0 mg/l

Detectable concentrations of manganese were found in two of the 10 samples collected in 1972. During the June cruise, water samples from the State Line and Calumet River Mouth stations yielded manganese concentrations of 0.01 and 0.04 mg/l, respectively. These values were below the limits of both the general and Lake Michigan standards.

MERCURY

General Standard: Shall not exceed 0.0005 mg/l

Of the 10 samples analyzed for mercury in 1972, only one yielded detectable concentrations. A sample collected at the State Line station during the October cruise had a mercury concentration of 0.0002 mg/l.

NICKEL (total)

General Standard: Shall not exceed 1.0 mg/l

No detectable levels of nickel were detected in the 10 samples analyzed in 1972.

SELENIUM (total)

General Standard: Shall not exceed 1.0 mg/l

No detectable levels of selenium were found in eight samples analyzed in 1972.

SILVER (total)

General Standard: Shall not exceed 0.005 mg/l

No detectable concentrations of silver were present in the 10 samples collected from within the Calumet Harbor basin in 1972.

ZINC

General Standard: Shall not exceed 1.0 mg/l

Detectable concentrations of zinc were found in one of 10 Calumet Harbor samples in 1972. A zinc concentration of 0.1 mg/l was recorded at the State Line station during the September cruise.

LAKE BED SURVEY

The State of Illinois has annually conducted a lake bed survey beginning in 1968. The authority to conduct this survey was provided in Senate Bill 1794 of the 75th General Assembly. This legislation required the annual collection and evaluation of information to determine the status of the quality and ecology of Lake Michigan.

Regulations incorporated into the 1972 Water Pollution regulations of Illinois state that all waters of the state shall have: "Freedom from unnatural sludge or bottom deposits, floating debris, visible oil, odor, unnatural plant or algal growth, unnatural color or turbidity, or matter in concentration or combinations toxic or harmful to human, animal, plant, or aquatic life of other than natural origin."

To evaluate the Lake Michigan environment one hundred and fourteen benthos samples were collected in 1972 using the Peterson and Ponar dredges. Each sample was washed through a 30 mesh screen. The remaining portion was preserved for later identification of the collected organisms. Each sample was classified as containing a balanced population of aquatic organisms or a degraded population. The system of classification is based on the presence or absence of intolerant aquatic organisms as indicated below:

ENVIRONMENTAL CLASSIFICATION

(Based on the Presence or Absence of Intolerant Aquatic Organisms)

1. Many in number, many in species, or more in numbers than other forms present and approximately equal in number of species, or more in number of species. BALANCED
2. Less in number than other forms combined, but combined with moderate forms they outnumber tolerant forms, or similar in numbers to moderate forms but fewer in species. Tolerant forms less than or equal to intolerant forms. UNBALANCED
3. Few, if any, present. Other forms more numerous, or no intolerant forms present. Moderate and facultative forms present. SEMI-POLLUTED
4. Only tolerant forms present and usually many in numbers, or only tolerant forms present and few in numbers or no organisms present. POLLUTED
5. Natural or artificial bare area.

Generally a polluted condition is indicated by a population of 100 or more aquatic worms per square foot of bottom and a clean water situation is indicated by 150 scuds per square foot of bottom. Areas of high organic enrichment are indicated by aquatic worm populations in excess of 200 per square foot. These criteria are considered together with the numbers and species of all organisms found in a sample to give the final classification. A well balanced population will include a variety of species.

A degraded environment usually reduces the total number of species while it increases the number of individuals of the few remaining species which are more tolerant of polluted conditions.

RESULTS AND EVALUATION OF MONITORING

ESTABLISHED STATIONS

Dredge samples were collected at fifty nine established stations from Zion to Calumet Harbor in 1972 (Figure 3). The stations ranged from less than a mile to five miles offshore. Depths at which samples were taken ranged from fifteen to ninety two feet. Fifty three percent of these stations were indicative of a biologically degraded condition (Tables 51 and 52). The number of stations indicating a biologically degraded environment have remained near the fifty percent figure since 1969.

Areas of high organic enrichment were indicated at stations with worm populations in excess of 200 per square foot of bottom. In 1972 these conditions were found at stations 1, 3 and 23. The number of worms found were 392, 1000, and 397 per square foot at stations 1, 3 and 23, respectively.

Sixteen of the routine stations had scud populations in excess of 150 per square foot of bottom. Eight of these were located along Lake County from Zion to Highwood. Generally populations of this size indicate a clean water condition. Considering other factors, three of these stations were classified as biologically unbalanced. Stations with a balanced population and scud populations in excess of 150 per square foot were found at station numbers 2, 4, 5, 8, 12, 15, 34, 42, 44, 53, 54, 58, and 59. The bottom type at the majority of these stations was in a natural state and was usually a fine sand.

SPECIAL STATIONS

Forty five samples were collected from eight inshore areas within one mile from shore. Samples were collected at depths ranging from 5 to 85 feet, offshore from the Commonwealth Edison plant in Zion, the Commonwealth Edison plant in Waukegan, Waukegan harbor, Wilmette harbor, Belmont harbor, Monroe street harbor, and Calumet harbor. Ten samples were collected at the U.S. Established Dump Area at depths between 50 and 85 feet at distances 9½ to 13½ miles offshore from Chicago. Sixty four per cent of the fifty five special stations were indicative of a biologically degraded environment.

Commonwealth Edison-Zion (Figure 4)

Eleven samples were collected ½ to 1 mile offshore from the Commonwealth Edison-Zion plant at depths from 10 to 35 feet. Bottom type at all stations was fine sand. Nine of the samples were indicative of a balanced environment, one polluted (station 1) and one unbalanced (station 9). The nearest known source of pollution is the flow from Bull Creek which enters the lake just south of the Commonwealth Edison plant. The Zion plant was not in operation during 1972.

Commonwealth Edison-Waukegan (Figure 5)

Ten samples were collected at distances ½ to 1 mile offshore from the Commonwealth Edison plant in Waukegan at depths between 10 and 50 feet. Half of the stations were classified as either unbalanced (stations 3, 4 and 7) or semipolluted (stations 6 and 9). Fine sand comprised the bottom type at all stations except station 9 where gravel and rock were found.

Figure 3. Locations and pollutional classification of established stations from Zion to Calumet harbor.

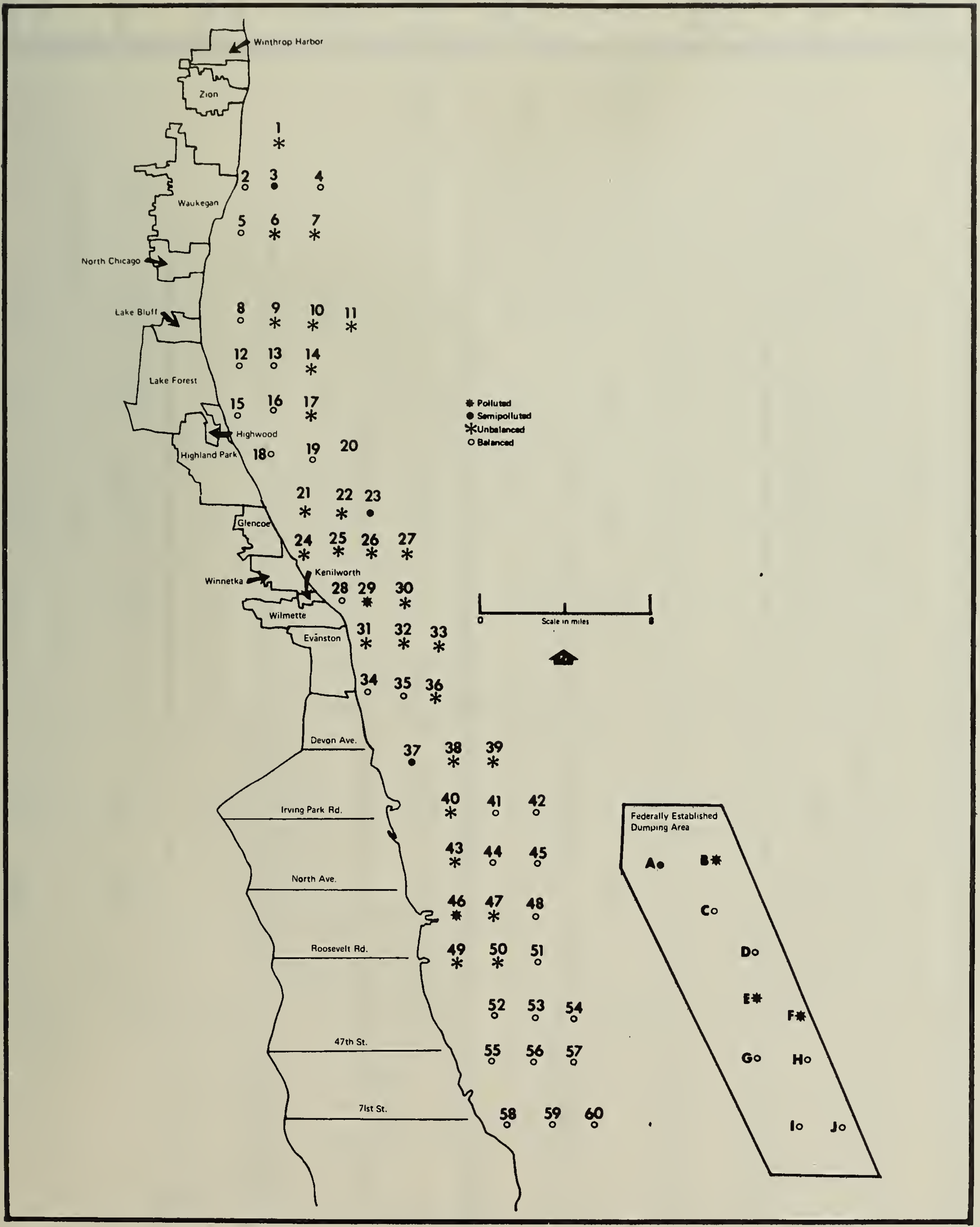


Table 51. Bottom organisms collected during benthic surveys from Zion to Kenilworth. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS
1	-	387	-	454	1	34	-	3	-	392
2	-	982	-	27	-	8	-	2	1	37
3	-	64	-	876	18	235	-	-	-	1000
4	-	682	1	286	1	18	-	-	-	22
5	-	717	-	290	20	16	-	4	-	11
6	-	85	-	250	10	51	-	1	-	-
7	-	1000	-	1200	4	27	-	2	-	-
8	-	885	-	88	1	25	-	-	-	22
9	-	1	-	-	-	5	-	1	-	4
10	-	1	1	5	-	5	-	-	-	23
11	-	32	-	70	-	17	-	-	-	9
12	-	651	-	249	11	9	-	28	-	-
13	-	41	-	2	-	8	-	-	-	9
14	-	69	-	127	2	16	-	1	1	16
15	-	281	-	12	-	18	-	-	-	95
16	-	25	-	4	28	4	7	-	-	7
17	-	3	1	-	-	1	-	2	-	5
18	-	91	-	17	7	4	-	-	-	3
19	-	16	-	-	-	2	-	4	1	1
20	-	-	-	-	ROCK INSUFFICIENT SAMPLE			-	-	-
21	1	8	-	1	7	4	-	29	-	6
22	-	6	-	10	1	9	1	2	-	84
23	-	21	-	4	-	23	-	1	-	397
24	18	123	-	9	40	41	14	55	-	171
25	-	20	-	13	-	2	-	3	1	50
26	-	4	-	2	1	17	-	-	13	76
27	-	2	-	4	2	12	-	-	2	18
28	-	137	-	4	-	71	-	-	9	18
29	-	4	-	-	-	110	-	2	-	-
30	-	7	-	294	-	37	-	-	14	196

Table 52. Bottom organisms collected during benthic surveys off Evanston and Chicago. Data are expressed as numbers of organisms per square foot.

CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORMS	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
-	16	8	1	22	-	15	2	-	17	UB
-	16	-	-	-	5	-	7	7	57	UB
1	13	-	-	2	-	6	12	-	-	UB
-	188	-	52	15	10	-	-	-	6	B
-	59	-	11	-	5	-	2	2	-	B
-	48	-	18	2	9	-	12	-	30	UB
-	-	-	11	-	3	-	4	1	-	SP
1	4	-	3	-	22	-	-	-	2	UB
-	4	-	4	-	11	-	2	-	14	UB
-	5	-	-	4	-	-	2	-	2	UB
-	14	-	2	-	2	-	-	-	-	B
-	317	-	7	-	5	-	-	-	89	B
-	242	-	303	16	100	-	4	32	178	UB
-	331	-	43	12	7	-	2	-	10	B
-	46	-	-	-	7	-	-	-	-	B
-	-	-	-	-	-	-	-	-	-	P
-	8	-	3	-	9	-	1	-	4	UB
-	26	-	-	-	1	-	-	-	4	B
2	10	-	19	7	17	-	1	1	-	UB
-	12	-	11	4	9	-	5	-	-	UB
-	11	-	-	2	5	-	-	-	5	B
-	26	-	8	2	13	-	-	-	-	B
-	269	-	48	19	7	-	1	1	-	B
-	180	-	7	1	4	-	-	-	-	B
1	149	-	48	5	5	-	1	-	4	B
1	120	-	15	2	10	-	-	-	6	B
-	31	-	5	-	3	-	-	-	4	B
2	278	-	140	16	29	-	12	4	5	B
-	308	-	48	28	4	-	-	-	10	B
-	24	1	5	1	-	-	2	-	-	B

Figure 4. Location and pollution classification of stations sampled offshore from the Commonwealth Edison Zion plant. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		3				2				93	P
2		116				4				31	B
3		206		23		3		2		30	B
4		76		32		1				2	B
5		77								3	B
6		31				10				3	B
7		47				3				13	B
8		106		3				1		4	B
9		446		293	7	1		1	1	320	UB
10		483		125	1	3		4		182	B
11		241		12		4				28	B

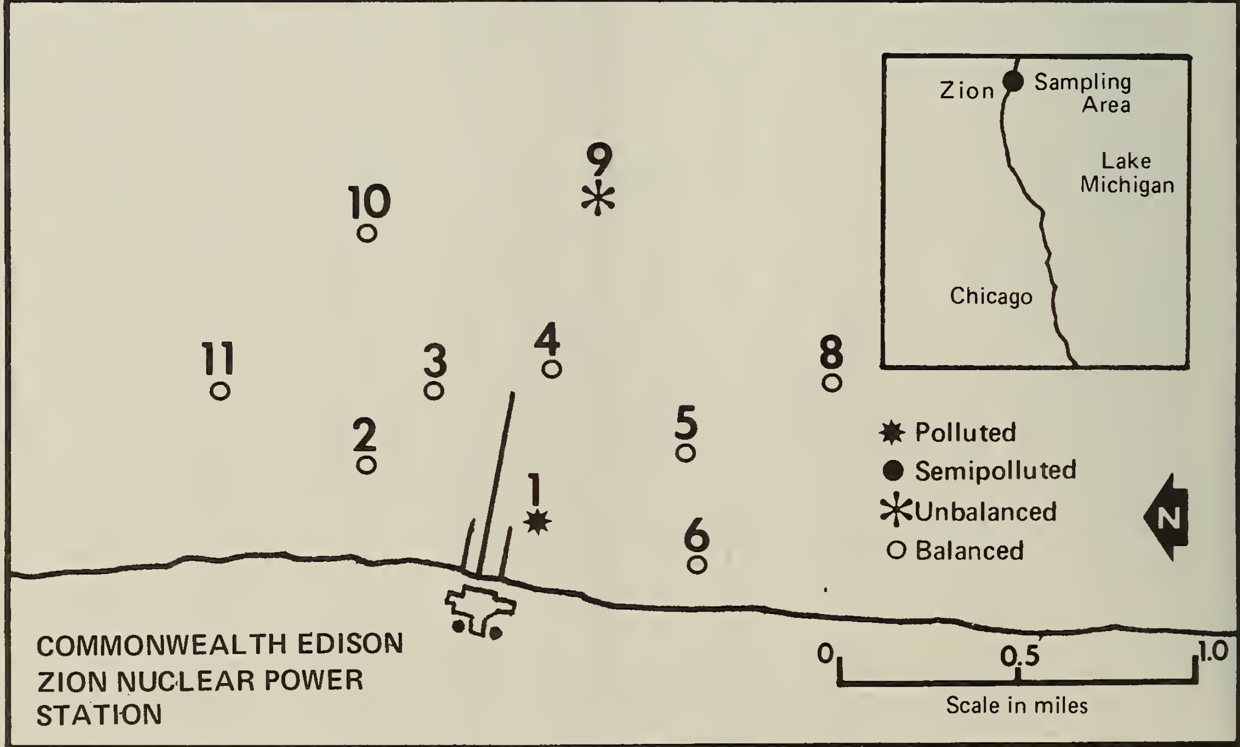
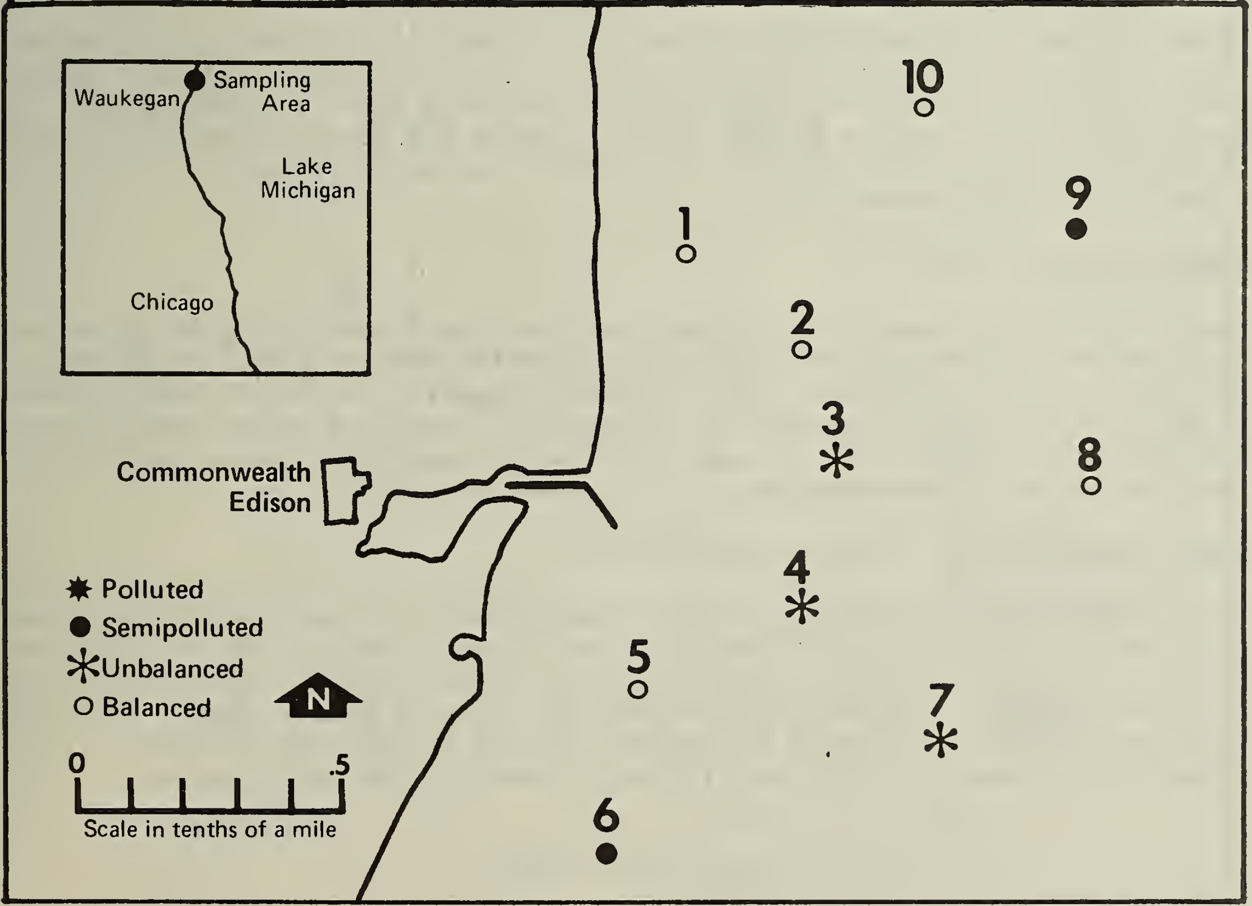


Figure 5. Location and pollutional classification of stations sampled offshore from the Commonwealth Edison Waukegan plant. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		114									B
2		181		33	2	3				13	B
3		300		437	12	3		10		109	UB
4		239		138	3	6		4		160	UB
5		236		3		1				3	B
6		27		3		1				149	SP
7	1	445		287	8	4		5		269	UB
8		275		14	1	1				109	B
9		3		59	4	4		1		122	SP
10		279		197	7	3		4		67	B



Waukegan Harbor (Figure 6)

All four samples collected in Waukegan harbor were indicative of a polluted environment. Stations one through four were collected at depths ranging between 20 and 28 feet. Bottom type at each station was highly organic in nature. Because of the extent of polluted conditions an exact source of pollution could not be traced.

Wilmette Harbor (Figure 7)

Three stations were surveyed in Wilmette harbor. All were indicative of a degraded condition. Station 1 classified as unbalanced was collected at a depth of 5 feet with a bottom type of sand and detritus. Station 2 classified as polluted was collected at the same depth with a similar bottom type. Over 2500 aquatic worms per square foot were found at this station. Station 3 was classified as semipolluted and was collected at a depth of 12 feet with a bottom type of clay and rock.

During periods of extremely heavy rainfall the Wilmette locks are opened to allow the discharge of the North Shore Channel of the Chicago River to flow into the harbor and Lake Michigan. Although this discharge is only occasional it contributes to the degraded condition of the harbor. There are pumpout facilities available in the harbor for the disposal of shipboard wastes.

Montrose Harbor (Figure 8)

Three stations were sampled in Montrose harbor each of which was classified as polluted. Aquatic worm populations in excess of 1100 per square foot were found at each station. A highly organic bottom type was also found at each station. Sample depths ranged from between 20 and 22 feet. There are no known pollutional discharge to Montrose harbor. The Chicago Park District provides pumpout facilities for the disposal of shipboard wastes.

Belmont Harbor (Figure 9)

Four stations were sampled in Belmont harbor and each was classified as polluted. Stations one through four were collected at depths ranging from 8 to 24 feet. Bottom type at each station was highly organic. Aquatic worms were found in excess of 9000 per square foot at stations 2, 3 and 4. There are no known pollutional discharges to the harbor. The Chicago Park District provides pumpout facilities for the disposal of shipboard wastes.

Monroe Street Harbor (Figure 10)

Five samples were collected in Monroe street harbor with each indicating a degraded condition. A highly organic bottom type was found at stations one through four. Aquatic worm populations in excess of 400 per square foot were found at each of the five stations. Sample depths ranged from 14 to 32 feet in depth. There are no known pollution discharges to the harbor. The Chicago Park District provides pumpout facilities at this harbor for the disposal of shipboard wastes.

Figure 6. Location and pollutional classification of stations sampled in Waukegan harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		7		2100	14	7			36	3900	P
2		2		12					7	105	P
3				1110	7				392	6800	P
4				150		85			14	13600	P

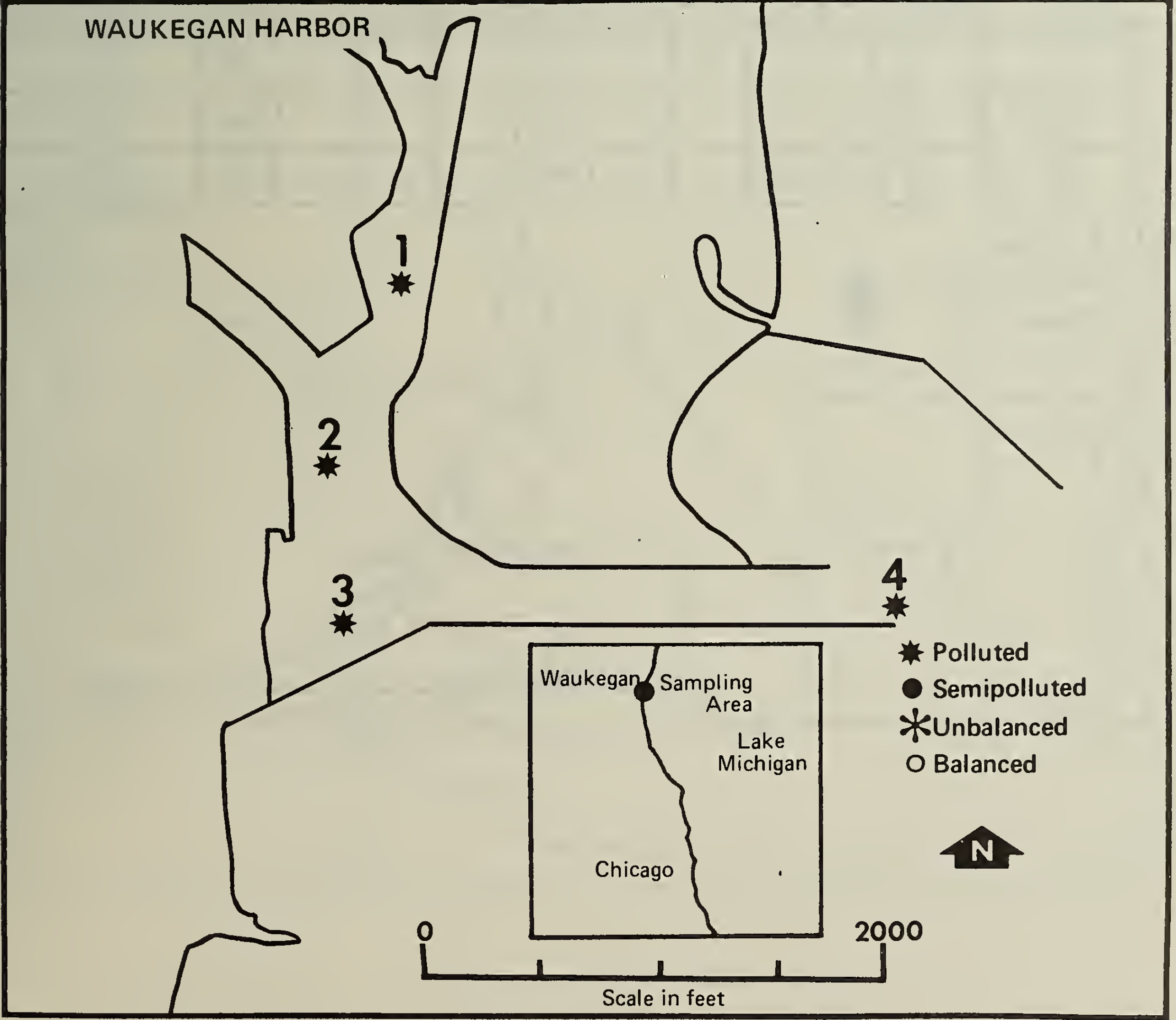


Figure 7. Location and pollutional classification of stations sampled in Wilmette harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		2	1	5		12			1	10	UB
2		29				42				2500	P
3		21	2			170	2			69	SP

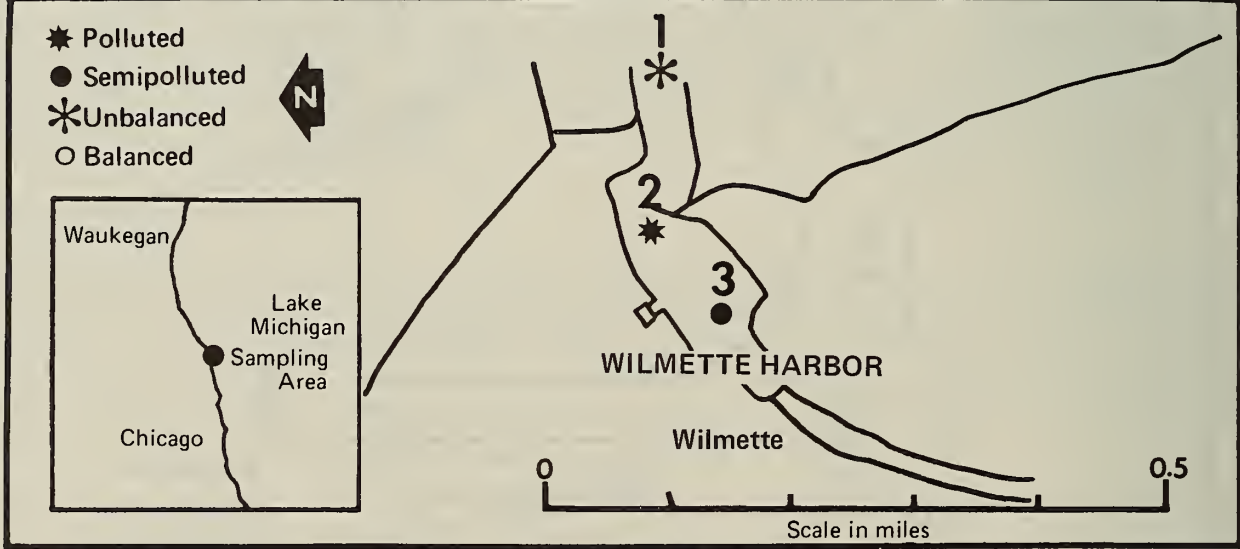


Figure 8. Location and pollution classification of stations sampled in Montrose harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		5		433	4	203			27	1100	P
2				456		153			9	8000	P
3				235	4	25			16	3200	P

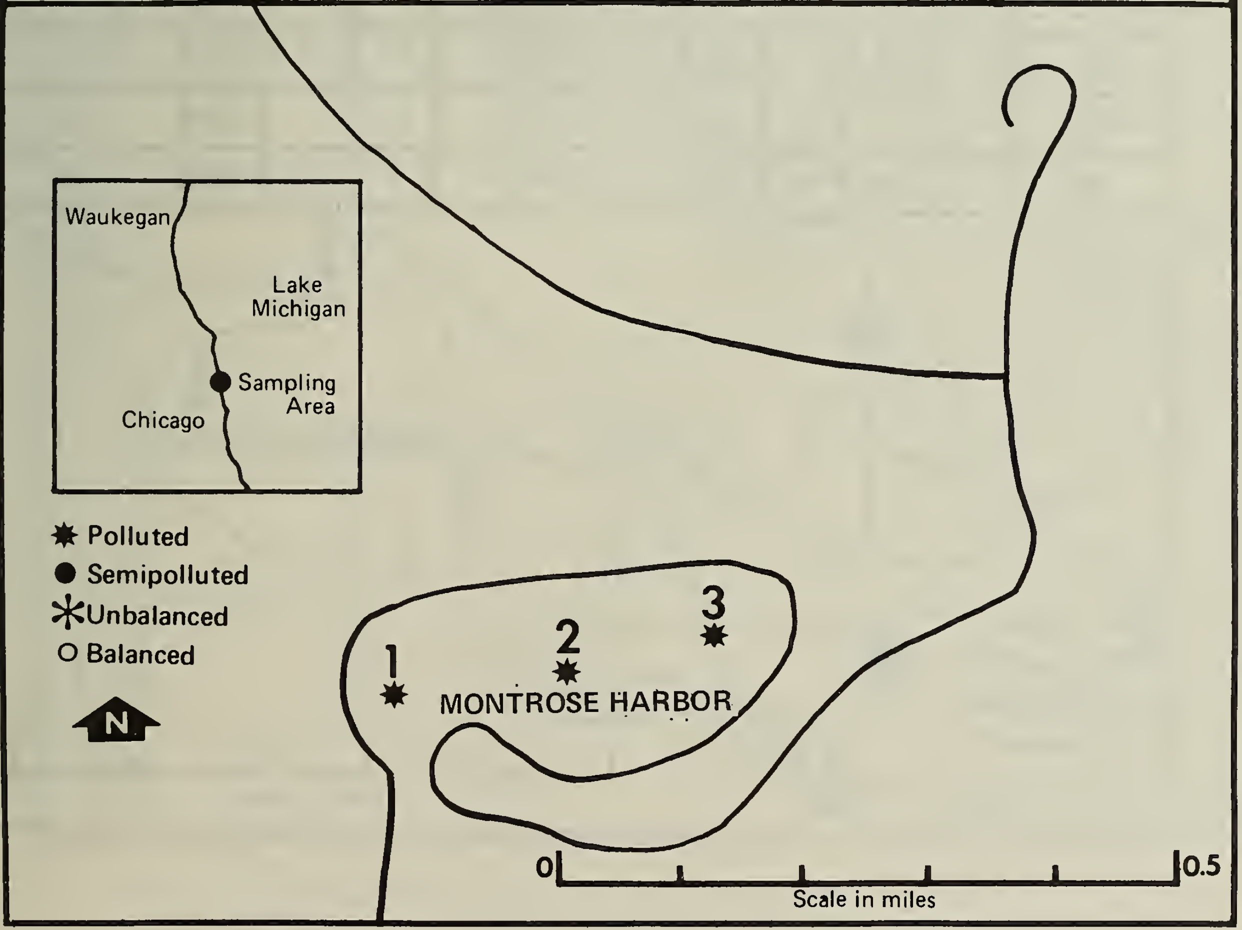


Figure 9. Location and pollutional classification of stations sampled in Belmont harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		34	5	9	2	23			7	598	P
2		18		230	2	198				10000	P
3		14		456	28	157		14		11000	P
4		174	12	584	12	214		2	28	9200	P

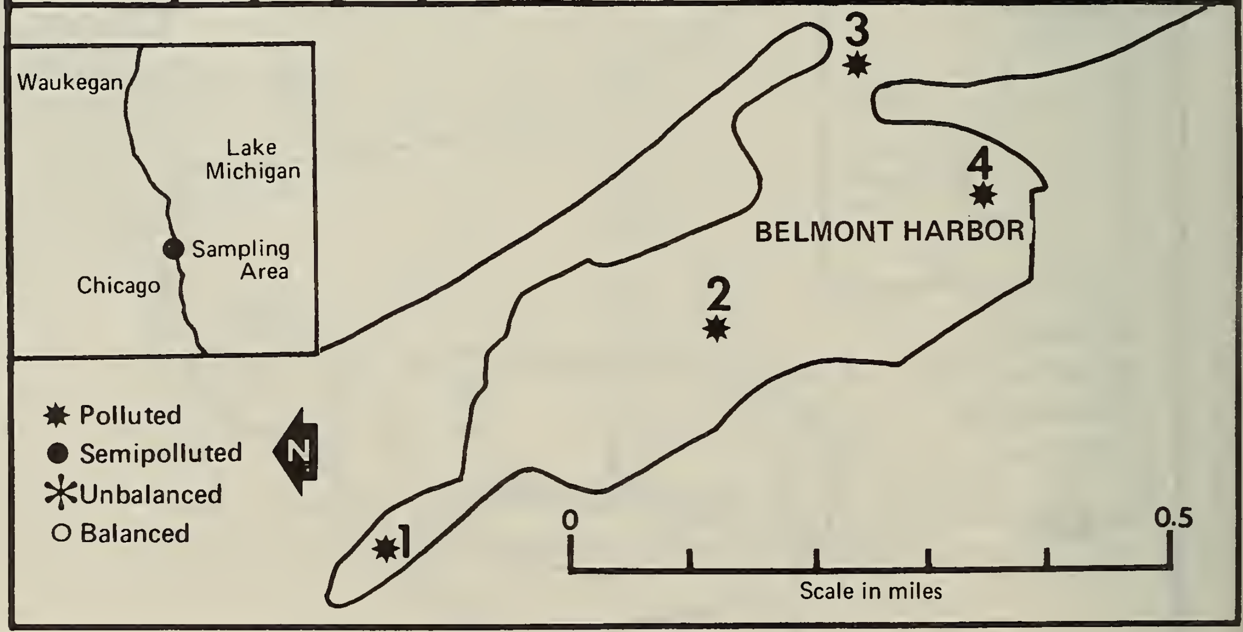


Figure 10. Location and pollutional classification of stations sampled in Monroe Street harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1		94	27	148	14	71			34	1500	SP
2		139	25	228	53	32		2	30	1200	SP
3		146	34	404	78	75		5	53	712	SP
4	2	155	4	635	5	144			5	6800	SP
5		457	66	173	205	20	7	12	18	854	UB

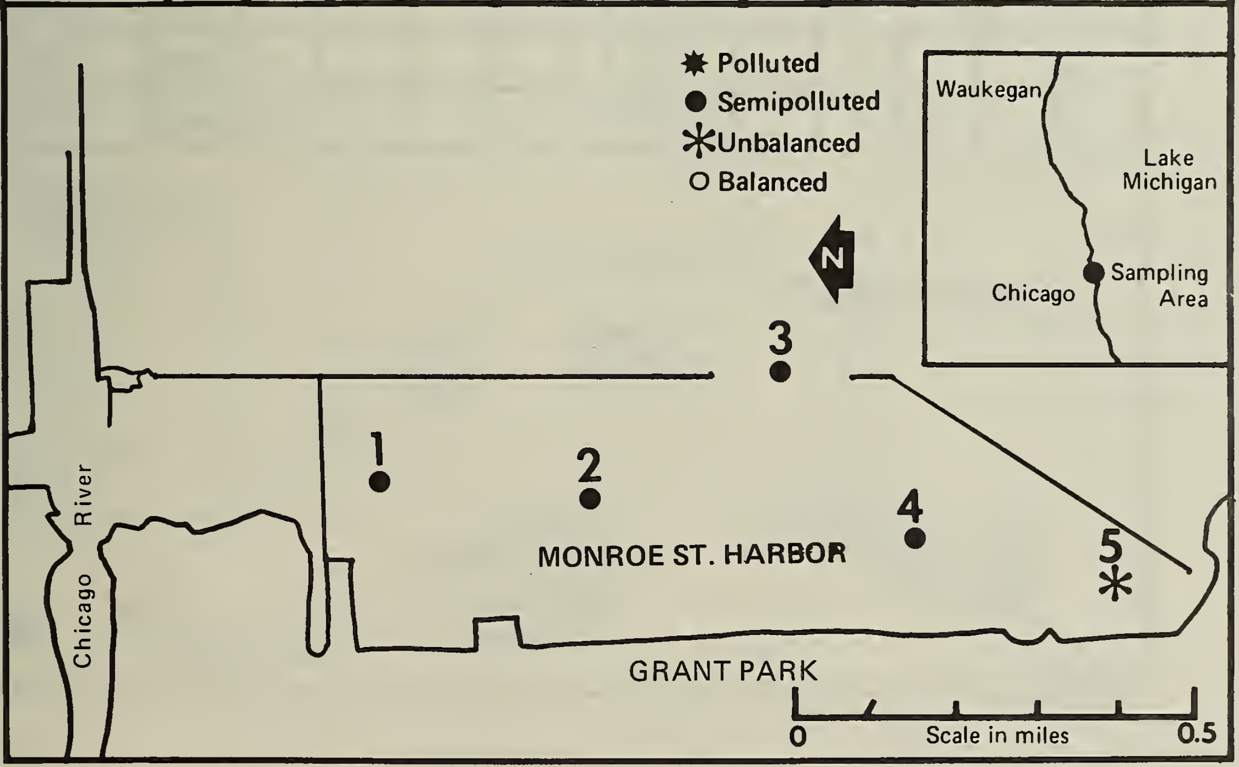
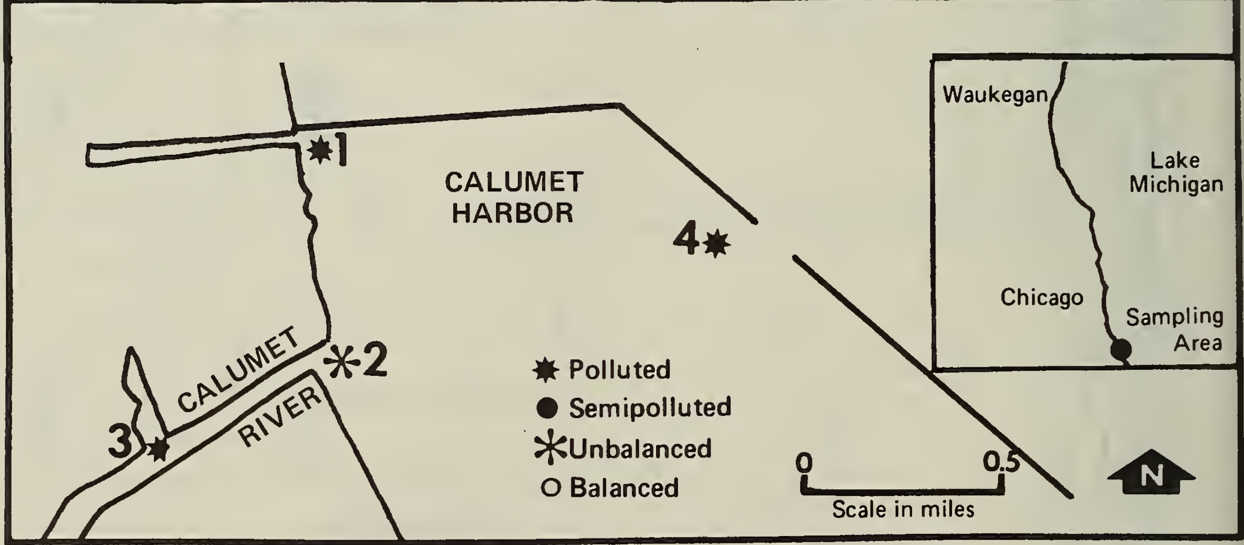


Figure 11. Location and pollutional classification of stations sampled in Calumet Harbor. Data are expressed as numbers of organisms per square foot.

STATION	CADDISFLY LARVAE	SCUDS	AQUATIC SOW BUGS	FINGERNAIL CLAMS	GILLED SNAILS	MIDGE LARVAE	FLATWORM	PULMONATE SNAILS	LEECHES	AQUATIC WORMS	POLLUTION CLASSIFICATION
1			2	148	27	4			55	185	P
2		2		2	5					4	UB
3		2		52	5				9	10800	P
4		2		265	14	11			12	2800	P



Calumet Harbor (Figure 11)

Four stations in Calumet harbor were sampled with each station indicating a degraded condition. Stations 1, 3 and 4 were classified as polluted and station 2 as unbalanced. Samples were collected at depths ranging from 30 to 34 feet in depth. Bottom type at these stations consisted mainly of organic muds and detritus. Because of the extent of polluted conditions an exact pollutional source could not be traced. The high organic nature of the harbor bottoms sampled probably does not reflect the impact of a single point source of pollution but rather the impact of man's continued activities in the watershed over many years. These activities include waste disposal, storm drainage, shipping, boating and others. Restricted circulation in harbors results in deposition of settleable materials.

U.S. Established Dump Area (Figure 3)

Ten stations were sampled at the U.S. Dump Zone. Six of the stations were classified as balanced, three as polluted and one as semi-polluted. Samples were collected at depths between 50 and 85 feet. Bottom type varied between fine sand, pebbles, and clay and combinations of each. Present state regulations prohibit the use of this area.

PHYTOPLANKTON SAMPLING

GENERAL INFORMATION

Phytoplankton are the minute, mostly microscopic plant organisms which drift in the water subject to the action of waves and currents. They form the base of aquatic food chains, and are the primary source of food for aquatic organisms and some fish.

Eutrophication, which is the natural aging process of a body of water, is accelerated by increased levels of nutrients. There is a causal relationship between nutrient levels and phytoplankton densities. Analyses of phytoplankton populations provide information on the phenomenon of eutrophication.

Phytoplankton, when present in high concentrations, cause taste and odor problems in public water supplies, shorten filter runs in water treatment facilities, lower lakefront property values, interfere with industrial water use, reduce levels of dissolved oxygen in water upon decay with possible deleterious effects on other aquatic life and may cause skin rashes in susceptible individuals.

RESULTS

During 1972, 134 phytoplankton samples were collected and identified to genus. Samples were collected at selected water treatment plant raw water supplies and public bathing beaches.

Samples were collected at Winthrop Harbor Main Street Beach, Zion-Benton water plant, North Chicago water plant, Lake Bluff Center Avenue Beach, Highland Park - Park Avenue Beach, Highland Park water plant, Winnetka water plant, Wilmette water plant, Wilmette Lake Avenue Beach, Evanston water plant, Chicago Touhy Avenue Beach, Chicago Oak Street Beach, Chicago Central water plant, Chicago South water plant, and the Chicago 100th Street Beach.

Of the major groups the green algae (Chlorophyta) and the yellow-greens (Chrysophyta) were the most abundant. The Green algae were found in all samples and the yellow-greens in 86% of the samples. The blue greens (Cyanophyta), euglenoids (Euglenophyta) and cryptomonads (Cryptophyta) followed in abundance in 54%, 12% and 6% of the samples respectively.

When total numbers are considered for all samples the most dominant groups were the yellow greens 48.5%, followed by the greens 43.3%, blue greens 7.8%, the euglenoids 0.3% and the cryptompnads 0.1%.

As in 1971 plankton data were also evaluated using the Palmer index. Plankton data were evaluated by assigning a rating to each of 20 genera based on its significance as a pollution indicator. The algal genus pollution index reported by Palmer assigns the following rating:

Anacystis	1
Ankistrodesmus	2
Chlamydomonas	4
Chlorella	3
Closterium	1
Cyclotella	1
Euglena	5
Gomphonema	1
Lepocinclis	1
Melosira	1
Micractinium	1
Navicula	3
Nitzchia	3
Oscillatoria	5
Pandorina	1
Phacus	2
Phormidium	1
Scenedesmus	4
Stigeoclonium	2
Synedra	2

In applying this index a genera is not considered present unless a count of at least or more per milliliter is obtained. An index rating of 20 or more indicates high organic pollution, 15-19 indicates possible evidence of high organic pollution, and val below 15 indicate the lack of organic pollution or other factors which may limit th production of these indicator genera.

An index value equal to or in excess of 20 was recorded in 9 of the 134 samples whil the annual average at all locations did not exceed 12. Locations recording high val in 1972 equal to or in excess of 20 were the Chicago Central water plant, Chicago 10 Street Beach, Chicago Oak Street Beach, Chicago Touhy Avenue Beach, Wilmette Lake Av Beach, and Lake Bluff Center Avenue Beach.

The highest index value of 28 was obtained at the Chicago Oak Street Beach on 7/25/7 (Table 53). Touhy Avenue Beach in Chicago recorded high values of 20 on 9/18/72 and 26 on 7/25/72. The 100th Street Beach in Chicago recorded values of 21 on 7/25/72, 24 on 9/18/72, and 21 on 10/16/72. The Chicago Central water plant recorded a high value of 20 on 6/12/72. An index of 20 was obtained at the Wilmette Lake Avenue Beach on 9/18/72 and at the Center Avenue Beach of Lake Bluff on 10/16/72.

There are no discharges of heavy organic loading to Lake Michigan which could be correlated to the high index values. This background data on index values together with population densities may be of value in determining enrichment of the lake over a long period of time. Sampling in 1972 showed an increase in the green and blue green algae over 1971.

Table 53. Palmer pollution index scores for phytoplankton samples collected in the Illinois portion of Lake Michigan in 1972.

SAMPLE LOCATION	Number of Samples	PALMER SCORES Range	Annual Average
Winthrop Harbor Main St. Beach	8	4-19	11
Zion-Benton Water Plant	8	0-4	3
North Chicago Water Plant	10	0-11	6
Lake Bluff Center Avenue Beach	8	0-20	9
Highland Park - Park Avenue Beach	8	0-19	11
Highland Park Water Plant	10	1-17	6
Winnetka Water Plant	10	0-7	3
Wilmette Water Plant	11	0-17	7
Wilmette Lake Avenue Beach	7	0-20	10
Evanston Water Plant	11	1-17	8
Chicago Touhy Avenue Beach	7	2-26	11
Chicago Oak Street Beach	7	2-28	9
Chicago Central Water Plant	11	0-20	4
Chicago South Water Plant	11	1-14	6
Chicago 100th Street Beach	7	1-24	12
	134		

SPECIAL SAMPLING

GENERAL INFORMATION

Potentially harmful contaminants have been found in Lake Michigan water. These include the chlorinated hydrocarbons, polychlorinated biphenyls, phthalates, and heavy metals. Monitoring programs by the Lake Michigan states are presently underway.

On November 9, 1972 at a public session of the Lake Michigan states and the U.S.E.P.A. a recommendation was made that the Lake Michigan Interstate Pesticide Committee be expanded in scope to include the investigation of toxic substances other than pesticides. The restructured committee called the Lake Michigan Toxic Substances Committee was charged with issuing periodic reports indicating the findings of the committee, progress, needs and recommended control programs.

PESTICIDES

On June 25, 1969, the Pesticide Control Law was passed in Illinois. The act provided for labeling of pesticides to prevent contamination of water and environment by regulating, restricting or prohibiting the sale, use or application of pesticides. The sale, use or application of DDT was prohibited in Illinois without a permit from the Director of the Department of Public Health, effective January 1, 1970.

Effective January 1, 1972 licensing of custom or public application of pesticides was established under the control of the Department of Agriculture.

On March 24, 1972, at a public hearing, the Interagency Committee approved rules and regulations to the Pesticide Control Law promulgated by both the Department of Agriculture and the Department of Public Health. These rules and regulations prohibit the sale, use or application of sodium fluoroacetate (1080) and fluoroacetamide (1081) effective July 1, 1972, except by prior permit from the department having jurisdictional control.

Chlorinated hydrocarbon pesticides are undesirable in the environment because they may persist for months and years following application. In 1972, analyses were performed by the Illinois Environmental Protection Agency for p, p' - DDD, o, p' - DDD, p, p' - DDT, o, p' - DDT, p, p' - DDE, o, p' - DDE, heptachlor epoxide, dieldrin, methoxychlor, lindane, heptachlor, aldrin and endrin in water and fish samples.

POLYCHLORINATED BIPHENYLS

The polychlorinated biphenyls have recently been found in Lake Michigan water, sediment and fish. PCB's, which are extremely persistent chlorinated hydrocarbons, have been found to accumulate through food chains of fish and birds, and may have an effect on reproductive potential on these as well as other forms of wildlife.

PCB's are used in the production of adhesives, asphalt, elastomers, electrical insulation, fire-resistant heat transfer and hydraulic fluids, special lubricants, sealants and expansion media, synthetic rubber, floor tile, printers ink, coatings for paper and fabrics, pigments, resin, paints, varnishes and waxes.

In 1972 data was collected on Aroclor 1242 and Aroclor 1254 in water and fish samples.

PHTHALATES

Phthalates are chemical compounds of recent environmental concern. They are used as plasticizers in the plastics industry, particularly in the production of polyvinyl chloride plastics.

Two phthalate esters, DOP [di (2-ethylhexyl) phthalate] and DBP [di-n-butyl phthalate], have been encountered in the routine analysis of Lake Michigan water for DDT. Subsequent investigations by others have confirmed the presence of phthalates in fish, especially those taken from bodies of water associated with large urban and industrial areas.

HEAVY METALS

The heavy metals have been monitored in order to determine baseline levels presently found in the Illinois portion of Lake Michigan. Continuous monitoring can then be used to determine trends of these potentially dangerous materials. In 1972 parameters analyzed included arsenic, barium, boron, cadmium, chromium (hex), chromium (tri), copper, iron (dissolved), iron (total), lead, manganese, mercury, nickel, selenium, silver and zinc.

RESULTS OF MONITORING

PESTICIDES, POLYCHLORINATED BIPHENYLS AND PHTHALATES

WATER SAMPLES

Twenty nine water samples were collected at Pettibone Creek, the Waukegan River and the North Shore Sanitary District sewage treatment plants at North Chicago and Waukegan (Table 54). Lindane, Aldrin, Endrin, Heptachlor, and o, p' - DDE were not present at detectable levels.

DBP (di-n-butyl phthalate) and Aroclor 1254 were found in higher concentrations than the pesticides at both sewage treatment plant and stream stations. Values found were most often near 100 ppt.

Concentrations of the pesticides, PCB's and phthalates were similar for streams and sewage treatment plants except for higher values of dieldrin and total DDT, consistantly found in the sewage treatment plants. Sewage treatment plants most often had highest values of the pesticides. The North Shore Sanitary District plant at North Chicago had maximum values for heptachlor epoxide (81.0 ppt) and dieldrin (29.2 ppt). The North Shore Sanitary District plant at Waukegan had maximum values for DOP (2800.0 ppt), DBP (1200.0 ppt), o, p' - DDT (74.6 ppt), p, p' - DDE (44.0 ppt), p, p' - DDD (13.0 ppt), and p, p' - DDT (132.6 ppt). Aroclor 1242 was not found in sewage treatment plant effluent in the majority of the samples.

Table 54. Pesticides, PCB's, and phthalates found in water samples from Illinois streams and sewage plants tributary to Lake Michigan in 1972. Values are expressed in parts per trillion (ppt)

SAMPLE LOCATION	DATE COLLECTED	HEPTACHLDR EPOXIDE	DIELDRIN	METHOXYCHLOR	DOP	DBP	o,p' isomers			p,p' Isomers			TOTAL DDT	Aroclor	
							DDE	DDD	DDT	DDE	DDD	DDT		1242	1254
Waukegan River	5/24/72	3.1	2.6	27.2	---	107.0	ND	ND	11.7	7.1	2.8	36.5	58.1	62.0	114.0
Waukegan River	5/23/72	3.4	2.1	22.6	---	92.0	ND	ND	12.5	10.2	1.7	35.0	59.4	120.0	136.0
Waukegan River	5/25/72	4.5	2.0	29.4	---	77.0	ND	ND	9.8	5.4	1.9	22.7	39.8	57.0	61.0
Waukegan River	6/29/72	3.8	2.6	29.5	---	D	ND	0.7	2.3	12.9	6.7	22.2	44.8	84.0	119.0
Waukegan River	8/30/72	2.5	<1.0	ND	ND	ND	ND	ND	1.0	3.4	4.7	2.8	11.9	ND	D
Waukegan River	9/26/72	2.0	3.0	ND	520.0	40.0	ND	ND	1.0	3.0	3.0	5.0	12.0	ND	---
Waukegan River	11/29/72	<1.0	2.0	ND	110.0	45.0	ND	ND	1.0	1.0	3.0	3.0	8.0	160.0	100.0
Pettibone Creek	5/24/72	1.6	3.1	65.5	---	122.0	ND	ND	12.5	4.7	2.0	38.4	57.6	ND	111.0
Pettibone Creek	5/25/72	1.2	1.7	72.4	---	147.0	ND	ND	7.2	3.9	2.4	26.3	39.8	ND	107.0
Pettibone Creek	6/29/72	2.6	3.7	89.1	---	110.0	ND	0.6	3.1	20.3	5.9	26.4	56.3	653.0	841.0
Pettibone Creek	8/30/72	2.3	3.9	ND	ND	ND	ND	ND	ND	5.1	9.9	8.5	23.5	ND	D
Pettibone Creek	11/29/72	2.0	6.0	ND	790.0	180.0	ND	ND	5.0	8.0	12.0	22.0	47.0	180.0	33.0
Pettibone Creek	12/13/72	5.0	2.0	ND	440.0	250.0	ND	ND	2.0	6.0	2.0	5.0	15.0	D	120.0
NSSD Waukegan STP	5/16/72	2.2	14.5	45.7	---	120.0	ND	ND	14.3	7.6	1.7	70.5	94.1	ND	139.0
NSSD Waukegan STP	5/19/72	2.9	11.6	36.5	---	100.0	ND	ND	21.4	7.9	4.3	68.2	101.8	ND	105.0
NSSD Waukegan STP	5/23/72	7.8	8.3	40.8	---	87.0	ND	ND	16.1	9.9	7.1	49.1	82.2	ND	97.0
NSSD Waukegan STP	5/22/72	3.7	12.5	37.4	---	65.0	ND	ND	74.6	42.6	9.2	132.6	259.0	ND	118.0
NSSD Waukegan STP	6/17/72	1.4	6.7	59.8	---	250.0	ND	ND	1.9	10.4	2.1	16.3	30.7	17.0	111.0
NSSD Waukegan STP	7/26/72	48.0	18.0	ND	2800.0	ND	ND	ND	7.0	44.0	13.0	49.0	113.0	ND	D
NSSD Waukggan STP	10/29/72	3.0	4.0	ND	550.0	150.0	ND	ND	2.0	3.0	2.0	7.0	14.0	510.0	160.0
NSSD Waukegan STP	12/12/72	4.0	10.0	ND	880.0	1200.0	ND	ND	6.0	10.0	7.0	13.0	36.0	D	200.0
NSSD North Chicago STP	5/22/72	1.6	29.2	20.7	---	55.0	ND	ND	53.5	37.4	6.5	110.9	208.3	ND	104.0
NSSD North Chicago STP	5/23/72	3.2	26.0	22.8	---	97.0	ND	ND	43.0	20.4	6.0	87.7	157.1	ND	100.0
NSSD North Chicago STP	5/16/72	2.3	25.5	28.3	---	58.0	ND	ND	32.2	18.2	5.2	77.5	133.1	ND	132.0
NSSD North Chicago STP	5/19/72	1.2	21.8	27.5	---	70.0	ND	ND	34.7	14.8	4.9	79.7	134.1	ND	161.0
NSSD North Chicago STP	6/17/72	1.2	6.3	26.6	---	206.0	ND	ND	1.6	7.7	1.5	10.6	21.4	21.0	178.0
NSSD North Chicago STP	7/26/72	81.0	12.0	ND	ND	ND	ND	ND	7.8	32.0	9.5	32.0	81.3	ND	D
NSSD North Chicago STP	11/27/72	3.0	4.0	50.0	640.0	330.0	ND	ND	ND	3.0	ND	28.0	31.0	160.0	55.0
NSSD North Chicago STP	12/12/72	6.0	7.0	ND	690.0	1100.0	ND	ND	3.0	7.0	2.0	10.0	22.0	D	110.0

DDP = di(2-ethylhexyl) phthalate
DBP = di-n-butyl phthalate
ND = Not Detected
D = Detected but not quantitated

Stream stations recorded maximum values for o, p' - DDD (0.7 ppt at the Waukegan Rive methoxychlor (89.1 ppt at Pettibone Creek), Aroclor 1242 (653.0 ppt at Pettibone Cree and Aroclor 1254 (841.0 ppt at Pettibone Creek).

There are no water quality standards for PCB's at the present time. The federal Interdepartmental Task Force on PCB's has proposed that PCB levels in rivers or lakes should not exceed 0.01 ppb. Most values recorded in 1972 exceeded the proposed level

FISH SAMPLES

The Technical Committee on Pesticides established by the Lake Michigan Enforcement C ference recommended that the concentrations of pesticides in fish should not exceed 1.0 parts per million DDT, 0.5 parts per million DDD, 0.1 parts per million dieldrin, and that all other chlorinated hydrocarbon pesticides, singly or combined, should no exceed 0.1 parts per million based on the wet weight of the tissue sampled.

Fourteen composite samples (69 individual fish) from two species of lake fish (yello perch and chubs) were analyzed for pesticides, PCB's and phthalates (Table 55).

The average total DDT level found in fish was 1.7 ppm which exceeded the Lake Michig Interstate Pesticide Committee's recommendation of 1.0 ppm. The highest average tot DDT concentration of 4.6 ppm was found in a sample of chub males. The range of concentrations for all fish was from 0.1 to 4.6 ppm. While 7 of the composite samples exceeded the recommended DDT level, all samples were below the 5.0 ppm "action level" for DDT established by the U.S. Food and Drug Administration. Other than total DDT, only one other chlorinated hydrocarbon pesticide reached concentrations above 0.1 ppm. Dieldrin levels up to 0.2 ppm were recorded twice in chub samples from the Waukegan area. Concentrations of Heptachlor epoxide and di-n-butyl phthalate were 0.1 ppm or less.

Polychlorinated biphenyls in the composite samples ranged from 0.3 to 3.1 ppm with an average concentration of 1.7 ppm. The highest concentrations of PCB's were found in chub samples. Concentrations of 3.1 ppm were found in samples of female chubs. Samples of male chubs were similar with maximum values reaching 2.8 ppm. These concentrations were below the U.S. Food and Drug Administration's interim action level of 5 ppm.

DBP (di-n-butyl phthalate) concentrations were found at measurable levels only in chub samples. Measurable levels of DBP ranged between <0.1 - 0.1 ppm. Guideline concentrations for phthalates have not been developed.

Table 55. Pesticides, PCB's, and phthalates found in the edible portions of two species of Lake Michigan fish in 1972. Values are expressed in parts per million (ppm) on a wet weight basis.

SPECIES	NUMBER AND SEX ANALYZED	SIZE IN INCHES	SAMPLE LOCATION	DATE COLLECTED	HEPTACHLOR EPOXIDE	DIELDRIN	DBP	o, p' isomers DDE	o, p' isomers DDD	o, p' isomers DDT	p, p' isomers DDE	p, p' isomers DDD	p, p' isomers DDT	TOTAL DDT	AROCLOR 1254
Chubs	5 Male	8.5 - 10.0	Waukegan	5/25/72	<0.1	0.1	<0.1	0.1	<0.1	0.6	2.0	0.2	1.7	4.6	2.8
Chubs	5 Female	8.5 - 10.0	Waukegan	5/25/72	<0.1	0.1	<0.1	0.1	<0.1	0.3	1.2	0.1	0.9	2.6	2.5
Chubs	5 Female	9.0 - 9.5	Waukegan	5/25/72	<0.1	0.1	<0.1	0.2	<0.1	0.2	1.0	0.1	0.7	2.2	2.5
Chubs	5 Female	8.5 - 9.0	Waukegan	5/25/72	<0.1	0.1	<0.1	0.1	<0.1	0.2	1.0	0.1	0.6	2.0	2.8
Chubs	5 Female	8.0 - 8.5	Waukegan	5/25/72	<0.1	0.1	0.1	0.1	<0.1	0.3	1.3	0.1	0.9	2.7	2.9
Chubs	5 Female	8.5 - 10.0	Waukegan	5/25/72	<0.1	0.2	0.1	0.1	<0.1	0.3	1.2	0.1	1.1	3.0	2.9
Chubs	5 Female	8.5 - 10.0	Waukegan	5/25/72	<0.1	0.2	0.1	0.1	<0.1	0.3	1.2	0.2	1.2	3.0	3.1
Chubs	5 Female	8.0 - 8.5	Waukegan	5/25/72	<0.1	0.1	<0.1	0.1	<0.1	0.2	1.1	0.1	1.0	2.5	3.1
Yellow Perch	5 Female	8.0 - 9.5	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	0.3
Yellow Perch	4 Female	8.5 - 9.0	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3
Yellow Perch	5 Male	8.0 - 9.5	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3
Yellow Perch	5 Female	8.5 - 9.5	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	ND	<0.1	<0.1	<0.1	0.1	0.1	0.2
Yellow Perch	5 Male	9.0 - 9.5	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	ND	<0.1	0.1	<0.1	0.1	0.2	0.3
Yellow Perch	5 Male	8.0 - 9.0	Waukegan	6/28/72	<0.1	<0.1	ND	<0.1	ND	<0.1	0.1	<0.1	<0.1	0.2	0.3

DBP = di-n-butyl phthalate
ND = Not Detected

HEAVY METALS

WATER SAMPLES

Water samples were collected at the 31 beaches, 12 water treatment plant raw water intakes, and eight 5 mile open water stations in 1972. Over 8,000 analyses were made for the various heavy metals. Heavy metal concentrations found in beach-water, water treatment plant raw water, and offshore samples were low. Cadmium, chromium, nickel, selenium, and silver were not detected in any samples. Iron, zinc, copper, and manganese were found in highest concentrations. Average values of iron and manganese were 0.4 and 0.02 ppm respectively at the Illinois beaches. Zinc and copper showed average values of 0.2 and 0.09 ppm respectively at the offshore stations (Tables 9, 30, 49).

FISH SAMPLES

A total of 14 composite fish samples (70 fish) were analyzed for mercury and selenium in 1972. Yellow perch and chub samples were analyzed. Concentrations of both mercury and selenium averaged less than 0.1 ppm in these composites (Table 56).

Table 56. Concentrations of mercury and selenium found in edible portions of two species of Lake Michigan fish. Values are expressed as parts per million (ppm) on a wet weight basis.

SPECIES	NUMBER AND SEX OF FISH IN SAMPLE	SIZE RANGE IN INCHES	SAMPLE LOCATION	DATE OF COLLECTION	MERCURY (Parts Per Million)	SELENIUM (Parts Per Million)
Yellow Perch	5 Female	8.5 - 9.5	Waukegan	6/28/72	.021	.126
Yellow Perch	5 Female	8.0 - 9.5	Waukegan	6/28/72	.025	.090
Yellow Perch	5 Female	8.5 - 9.0	Waukegan	6/28/72	.020	.076
Yellow Perch	5 Male	8.0 - 9.5	Waukegan	6/28/72	.023	.101
Yellow Perch	5 Male	9.0 - 9.5	Waukegan	6/28/72	.023	.059
Yellow Perch	5 Male	8.0 - 9.0	Waukegan	6/28/72	.064	.078
Chub	5 Male	8.5 - 10.0	Waukegan	5/25/72	.085	.042
Chub	5 Female	8.5 - 10.0	Waukegan	5/25/72	.110	.051
Chub	5 Female	9.0 - 9.5	Waukegan	5/25/72	.047	.070
Chub	5 Female	8.5 - 9.0	Waukegan	5/25/72	.026	.043
Chub	5 Female	8.0 - 8.5	Waukegan	5/25/72	.038	.060
Chub	5 Female	8.5 - 10.0	Waukegan	5/25/72	.040	.033
Chub	5 Female	8.5 - 10.0	Waukegan	5/25/72	.045	.035
Chub	5 Female	8.0 - 8.5	Waukegan	5/25/72	.033	.030

LEGISLATIVE AND REGULATORY ACTION

The following material is a summary of the legislative and regulatory activities of the State of Illinois which have some bearing on the quality of Lake Michigan. The information covers the period up to and including 1972. The material is categorized under the following headings.

DUMPING

In October, 1967, Senate Bill 1794, approved unanimously, prohibited further deposition of any material in Lake Michigan except with the joint permission of the state pollution control agency (EPA) and the Illinois Department of Public Works and Buildings. To date, the only permits issued involve non-pollutional material, such as steel pilings, concrete structures or clean sand.

WATER CRAFT WASTE

On January 1, 1970, The State of Illinois Sanitary Water Board Rules and Regulations SWB-19, prohibiting discharge of marine toilet wastes, became effective. Although the rule allows for the use of treatment systems, none of the present systems for treating watercraft wastes have demonstrated the required degree of treatment. Therefore, retaining-type or incinerating toilets with residue discharge at approved on-shore facilities, are the only approved systems.

The City of Chicago has a local ordinance which makes unlawful the discharge of marine toilet wastes in Chicago harbors and inshore waters. This ordinance is effectively enforced by the Chicago Park District, which denies mooring permits to vessels that are not in compliance. Non-retaining type toilet systems must be officially sealed to make them inoperative while in Chicago harbors. The Chicago Park District provides free pump-out stations for servicing the retaining-type toilet systems. The stations are located at Montrose, Belmont, Diversey, Burnham, 59th Street and Jackson Park Harbors.

ENFORCEMENT

In July, 1970, the Illinois Environmental Protection Act came into effect. A Pollution Control Board of five members was appointed as a judicial body in pollution control activities. To regulate and enforce the act, an Environmental Protection Agency was formed. This agency assumed all of the pollution control responsibilities formerly delegated to the Illinois Department of Public Health. The Act included an Institute for Environmental Quality, which promotes research activities.

FINANCING

In November, 1970, Illinois voters approved the issuance of $750,000,000 in bonds to assist municipalities and sanitary districts in financing construction, expansion and improvement of sewage treatment facilities. Half of the funds thus provided were to be made available to the Metropolitan Sanitary District of Greater Chicago. The remainder was to be distributed among all the other municipalities and sanitary districts.

A state grant may provide up to 25% of the total project cost. The combination of state and federal grant programs make it possible for a municipality to receive assistance amounting to as much as 80% of the project cost.

By the end of 1972 the North Shore Sanitary District received a total of $24,605,400 in grant offers from the state.

STANDARDS

In September, 1966, the Illinois Sanitary Water Board adopted water quality standards (SWB-7) which include standards for Lake Michigan. These standards, along with implementation plans and compliance schedules, were approved by the U.S. Department of the Interior in January, 1968. The Illinois Pollution Control Board amended the standards in 1971.

On March 7, 1972, the Pollution Control Board adopted new water quality standards. Th changes are too numerous to summarize, but copies of the "Water Pollution Regulations of Illinois" are available on request from:

Division of Public Inquiries
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

LAKE MICHIGAN ENFORCEMENT CONFERENCES

The Lake Michigan Enforcement Conference was eliminated late in 1972 through the Federal Water Pollution Control Act of 1972. A final session of the Conference was held in Chicago on November 9, 1972. Final Conference recommendations were made for follow up by the Lake Michigan states including the status of compliance with earlier conference recommendations, chlorides, phosphorus, pesticides, polychlorinated biphenyls (PCB's), phthalates, selected trace metals, and taste and odor problems. A toxic substances committee was established and was to continue investigation of potentially harmful substances in Lake Michigan.

ILLINOIS DISCHARGES

INDUSTRIAL WASTE

ABBOTT LABORATORIES (Manufacturers of drugs, antibiotics and pharmaceuticals). Abbott operates a waste treatment plant which provides secondary (biological) treatment of their extremely strong industrial waste. Recent water pollution control improvements have been completed and, in an effort to reduce the impact at the point of discharge the effluent is mixed with spent process, cooling and storm water. The resultant discharge is generally within the state guidelines for effluent quality.

Current plans are to discharge Abbott's effluent to the North Shore Sanitary District, once the Gurnee facility is operational.

COMMONWEALTH EDISON COMPANY, WAUKEGAN STATION (Fossil fuel electric generating station). This plant has been operating since 1927. At full capacity, the maximum temperature rise through the condensers is 12°F. Extensive studies of the thermal plume on the localized portion of the lake have identified no adverse effects.

COMMONWEALTH EDISON COMPANY, ZION STATION (Nuclear fuel electric generating station).

Though portions of this facility were completed in 1972, the Atomic Energy Commission did not issue a permit for operation. At full capacity, the maximum temperature rise through the condensers is not expected to exceed 20°F. The Illinois Pollution Control Board has authorized the facility to utilize Lake Michigan for cooling, providing all the requirements listed in the thermal regulations are met.

FANSTEEL INCORPORATED, METALS DIVISION (Producers of corrosion-resistant metals used in electrical contacts, rectifiers, capacitors and chemical plants). Fansteel discharges industrial wastes to Pettibone Creek roughly one mile upstream of its confluence with Lake Michigan. Historically, the effluent has exceeded the state's guidelines for certain toxic chemicals.

In 1972 Fansteel agreed to eliminate their discharges to Pettibone Creek. They began construction of in-plant improvements and pre-treatment facilities. Upon completion of the project, Fansteel's partially treated wastes will be discharged to the North Shore Sanitary District for complete treatment.

JOHNSON MOTORS, DIVISION OF OUTBOARD MARINE CORPORATION (Manufacturers of outboard motors). The effluent from oil separating equipment is discharged to Waukegan harbor and through a ditch to Lake Michigan, several hundred yards north of Waukegan's North Beach. Metals concentrations are generally within the state guidelines. Occasional oil discharges seldom pass the barriers and baffles which cross the effluent ditch.

UNITED STATES STEEL CORPORATION, WAUKEGAN WORKS (Producers of stainless and carbon steel wire and springs). In-plant improvements and acid waste hauling for deep well disposal in Gary, Indiana, have resulted in major reduction of acid and metals discharged from this facility. The present discharge via several outfalls, occasionally exceeds the state's effluent guidelines.

UNITED STATES STEEL CORPORATION, SOUTH WORKS (Steel smelting plant). This plant presently has outfalls discharging to Lake Michigan and the Calumet River. A court order issued January 18, 1971 requires a closed cycle system by 1975.

SEWAGE

NORTH SHORE SANITARY DISTRICT There are only seven Illinois municipal sewage treatme plants tributary to Lake Michigan. They are all operated by the North Shore Sanitary District and are located in Waukegan, North Chicago, Lake Bluff, Lake Forest and Highland Park (3 plants). The Waukegan and North Chicago plants provide secondary (biological) treatment. The others are primary (sedimentation) sewage treatment plants. All provide disinfection (chlorination) of their effluent. Except for the Highland Park plant at Ravine Drive all the plants are operating at or in excess of their design capacities. Therefore, particularly during periods of rain or thaw, inadequatel treated waste is discharged to Lake Michigan. During the summer months, the excess flows are chlorinated, since all of these plants are in close proximity to public bat ing areas.

The North Shore Sanitary District is now engaged in an extensive construction program which, when completed, will divert all sewage effluent from the Lake Michigan watershed. The program provides for the diversion of the effluents from the Lake Bluff, Lake Forest and Highland Park plants to the District's Clavey Road sewage treatment plant (DesPlaines River watershed). The North Chicago sewage treatment plant effluen will be diverted to a new facility to be located in Gurnee (DesPlaines River watershe Supplementary treatment and phosphate reduction facilities will be provided at the Waukegan sewage treatment plant. The effluent from the Waukegan plant will then be pumped for discharge to the DesPlaines River.

In 1968, the District's voters passed a referendum providing $35 million for the initial phase of the expansion projects. The last of these bonds was reportedly issued in May, 1971. Construction at the Clavey Road sewage treatment plant was begun durin 1969, but litigation instituted by a group of Highland Park residents has resulted in delays of the project schedule. After six days of public hearings, the Illinois Pollution Control Board ordered the District, on March 31, 1971, to complete immediately and expeditiously its proposed expansion facilities. This order authorized the District to issue any additional bonds required to complete the program without the passage of a public referendum.

The March 31 order also imposed a ban on connections to sanitary sewers within the North Shore Sanitary District. This action was intended to stabilize the organic and hydraulic loading on the sewage treatment plants and to unify public support for the prompt completion of the district's project.

In June, 1971, the PCB denied the District's request for a variance from the phosphorus regulations for the plants which were destined to be abandoned upon completion of the improvement project. An appellate court reversed this decision and ruled in favor of the District in January, 1972. The District however, continued installation of the chemical feed apparatus and the equipment was operational by late 1972.

Following completion of certain interim improvements at the Clavey Road and Waukegan sewage treatment plants, the District requested a variance from the sewer connection ban in the areas tributary to these plants. The PCB granted the variance for the connection of 1000 living units and, after an appeal, increased the allowed addition to 5000 living units.

One-third of the new connections were to be apportioned to the Clavey Road facility with the remainder to be directed to the Waukegan sewage treatment plant. A connection ban remained in effect for the areas of Waukegan in which the sanitary sewers had been shown to be incapable of adequately transporting additional wastes.

The project completion schedule accepted by the Pollution Control Board shows completion dates extending into late 1974. Total costs, including the numerous interim measures, are expected to substantially exceed the projected 95.27 million dollars.

WATER PLANT WASTE

In October, 1969, the Illinois Sanitary Water Board officially recognized water filtration plant backwash water and settling basin sludge as pollutants. Adequate treatment of these wastes was required by July, 1972. Although few of the plants met this deadline, many were in the process of constructing the improvements.

The plants at which construction had not yet begun as of Dec. 31, 1972, are listed below:

Waukegan
Great Lakes Naval Training Center
Fort Sheridan
Highwood
Highland Park
Glencoe

M.S.D.G.C. OVERFLOWS

All of the lake shore municipalities in Cook County (Glencoe through Chicago) are served by the Metropolitan Sanitary District of Greater Chicago. Except for several surface drains, no sewers, within the jurisdiction of the District, discharge directly to Lake Michigan. The District's three major sewage treatment plants and combined sewers (sewage and storm water) discharge to a system of waterways which are tributary to the DesPlaines River. The waterways receive flow from Lake Michigan regulated by facilities at Wilmette, downtown Chicago and the O'Brien lock on the Calumet River.

Lock and dam facilities prevent back-flow of contaminated river water into Lake Michigan. Heavy rains may cause such heavy discharge to these waterways that the water level rises above the level of the lake resulting in back-flow through the locks and overflow of the dams. Therefore, the District maintains an alert system with the Lockport control facilities. Whenever heavy rain is predicted, the Lockport Dam lowers the water level in the rivers and thereby prevents or minimizes the discharge from the MSDGC waterways to Lake Michigan.

Due to heavy rains on three different days in 1972, contaminated river water was discharged to Lake Michigan.

June 14, 1972	20 million gallons at Wilmette
August 26, 1972	191 million gallons at Wilmette
August 26, 1972	59 million gallons at downtown Chicago
August 26, 1972	59 million gallons at O'Brien Lock
September 17, 1972	90 million gallons at Wilmette

Prior to these incidents the last recorded reverse flow was October 10, 1969.

MILITARY INSTALLATIONS

There are two military installations in Illinois with sewage treatment plants tributary to Lake Michigan. The Great Lakes Naval Training Center and Fort Sheridan have facilities providing secondary treatment and disinfection.

The Great Lakes Naval Training Center has completed negotiations with the North Shore Sanitary District and a 10 million dollar project has been approved for connection to the new facility at Gurnee, once it is completed. As an interim measure, the Navy let a contract in excess of $70,000 for chemical addition to reduce the phosphorus content of the effluent. The use of chemicals was to begin in 1972.

The facility at Fort Sheridan is currently operating at less than design capacity due to the Army's transferring of Fifth Army Headquarters. Negotiations to connect to the North Shore Sanitary District are pending a decision on the ultimate disposal of the base.

GLOSSARY

AMMONIA (NITROGEN) - A chemical parameter used to evaluate water quality. Ammonia nitrogen is found naturally in surface and ground waters as a result of the decomposition of nitrogenous organic matter. Industrial wastes and sewage effluents contribute to background concentrations.

BENTHOS - Bottom dwelling organisms. In this report only organisms retained in a U.S. Standard No. 30 sieve were used.

CHLORIDE - A chemical parameter used to evaluate water quality. Chlorides are one of the most common components of natural bodies of water. They may be of natural origin, or may be present as a result of agricultural runoff, sewage contamination or industrial discharges.

CYANIDE - A chemical parameter used to evaluate water quality. The presence of toxic cyanide in the aquatic ecosystem is primarily the result of industrial waste discharges. Industrial processes involving the scrubbing of gases at steel mills, metal cleaning and electroplating processes, and the effluents from gas works, coke ovens and from chemical industries are the major inputs of cyanide to the lake environment.

DETRITUS - A mixture of organic and inorganic material formed from the decomposition of dead plant and animal forms and from settleable mineral materials.

EUTROPHICATION - The natural aging process of a body of water.

FACULTATIVE AQUATIC ORGANISMS - Organisms that tolerate a wide range of environmental conditions.

FECAL COLIFORM - A group of bacteria, which inhabit the intestinal tracts of warm-blooded animals, and have been shown to be a reliable indicator of recent contamination by feces of warm-blood animals.

FECAL STREPTOCOCCI - A group of bacteria also used as "indicator organisms" for determining the sanitary quality of a body of water. Streptococci bacteria from plants and insects may yield positive test results.

FLUORIDE - A chemical parameter used to evaluate water quality. Fluorides occur in only certain types of rocks, and are not commonly found in significant concentrations in surface waters. They are used in the manufacture of glass, enamels and steel, for the preservation of wood and mucilages, in insecticides, in chemical industries and in public water supplies where fluoridation is practiced.

FOOD CHAIN - A progression of food organisms in the aquatic environment which range from a large number of microscopic forms to a smaller number of large forms which are dependent on the smaller forms for their ultimate survival. A typical food chain would range from phytoplankton to the zooplankton (animal plankton) to the fishes.

INTOLERANT AQUATIC ORGANISMS - Aquatic organisms which require an environment free from pollution in order to survive.

IRON (total) - A chemical parameter used to evaluate water quality. Iron may occur in natural waters through the leaching action of soluble iron salts from soil and rocks. Major sources of iron input to aquatic environments are iron and steel mills, the organic and inorganic chemical industries, petrochemical and fertilizer plants and glass ceramic processing industries.

METHYLENE BLUE ACTIVE SUBSTANCE - A component of synthetic detergents, MBAS is introduced into the aquatic environment primarily via the effluents of sewage treatment plants.

NITRATE PLUS NITRITE - A chemical parameter used to evaluate water quality. Nitrat are the metabolic end products of organic nitrogen decomposition. They are commonly found in surface waters as a result of the decomposition of organic nitrogen in polluted streams, and from sewage effluents, agricultural runoff, cesspool leaching and industrial discharges. Nitrites in natural waters result from bacterial action upon ammonia and organic nitrogen. Because they are readily oxidized to nitrates, nitrites are not normally found in significant concentrations in surface waters.

If present in sufficient concentrations in public water supplies, nitrates and nitrites may cause infant methemoglobinemia, a disease causing blood changes and cyanosis.

pH - pH is the logarithm of the reciprocal of the hydrogen ion concentration. In practice, it is the measurement of the hydrogen ion concentration. By definition the pH range is from 0, which is very acidic, to 14, which is very alkaline. Since the concentration of hydrogen ions regulates the degree of dissociation of many substances, pH may be a significant factor in determining limiting threshold concentrations in natural waters. Abnormal fluctuations in pH may be an indication of industrial waste discharges.

PHENOL - A chemical parameter used to evaluate water quality. Phenols are associated with industrial wastes from coal distillation processes, and the manufacture of plastics, dyes and disinfectants. In public water supplies inadequate chlorination of phenol contaminated water produces odor and taste problems. Phenols in water may be toxic to fish and also impart tastes to fish flesh.

PHOSPHORUS - A chemical parameter used to evaluate water quality. It is significant when present in excessive amounts. Eutrophication may be accelerated by high phosphorus levels. Phosphorus enters the aquatic environment via agricultura and surface runoff, indistrial waste discharges and sewage effluents.

PHTHALATES - A group of chemical compounds used as plasticizers in the plastics industry.

PHYTOPLANKTON - Phytoplankton are the minute, mostly microscropic plant organisms which drift in the water subject to the action of waves and currents. They are a primary source of food for aquatic organisms and some fish.

POLYCHLORINATED BIPHENYLS - A group of chlorinated hydrocarbons used in the production of a wide variety of materials including adhesives, lubricants, inks, varnishes and hydraulic fluids. Aroclor 1242 and Aroclor 1254 are two of the PCB's which have been found in Lake Michigan.

SULFATE - A chemical parameter used to evaluate water quality. Sulfates are a component of natural bodies of water. Abnormal fluctuations in background levels are usually the result of industrial waste discharges.

TOLERANT AQUATIC ORGANISMS - Aquatic organisms capable of surviving in a polluted environment.

TOTAL COLIFORM - A group of bacteria, which has been used in the past as "indicator organisms" for determining the presence of pathogenic bacteria in water. Because total coliforms include bacteria of soil, vegetable and other non-fecal origin as well as those of fecal origin, attempts to correlate total coliform counts with sewage contamination have been variable and generally unsatisfactory.

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